






DAY 1
BATTERY 2030+
ANNUAL CONFERENCE
7-8 May 2026
Turin, Italy
BATTERY 2030
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THE BATTERY R&I LANDSCAPE
Horizon Europe 2021-2027
Partnership on batteries 2020
Dec 2019
Jun 2019
Mar 2019
May 2018
Oct 2017
BATTERY 2030+
EUROPEAN BATTERY ALLIANCE
EBA250
Strategic action plan on batteries
BATTERY 2030+
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THE BATTERY R&I LANDSCAPE
Horizon Europe 2021-2027
Partnership on batteries 2020
Investing in a Climate-Neutral and Circular Economy
Dec 2019
Jun 2019
BATTERY 2030
Mar 2019
May 2018
Strategic action plan on batteries
EUROPEAN BATTERY ALLIANCE
EBA250
Oct 2017
BATTERY 2030
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Past ...
STAKEHOLDER SUPPORT
BATTERY 2030
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Present ...
A Brief on Battery 2030+
BATTERY 2030
BATTERY 2030+
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BATT-BRIDGE
New CSA: The BATTery agora: Bridging Research, Innovation, Data, Governance and Excellence
16 partners from 10 countries, started April 1st !
Legacy from Battery2030+, Batteries Europe, IPCEIs
European battery R&I eco-system: universities, RTOs, etc. + associated partners BEPA and JRC
Mission: Strengthen the European battery R&I ecosystem by bridging research, industry and policy
Community – Battery2030+ => BATT-BRIDGE!
SINTEF
JRC
BEPA
VDI|VDE|IT
zabala
E-RA
BATTERY 2030


Welcome!
April 27th 2026
Kristina Edström being awarded
"l'Ordre des Palmes Académiques"
by the French Ministry of Education
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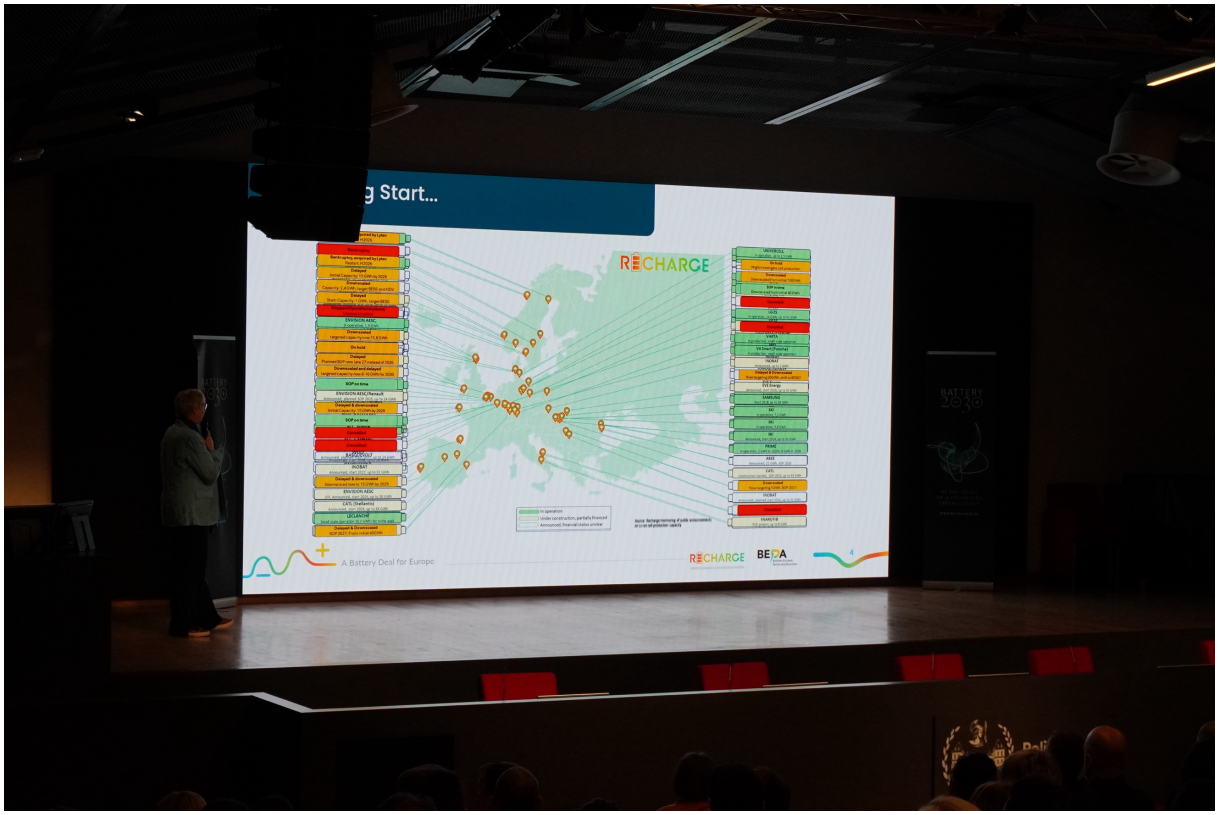
Start...
RECHARGE
A Battery Deal for Europe
RECHARGE
BEPA


What Are We Facing?
Political Acceptance
2035 ICE phase-out revision: Impact on demand?
Trade tensions: navigating EU–US–China battery dynamics
Social Dimension
Affordability: Can consumers realistically switch to EVs? And do they want to?
Support Landscape: Uneven EV demand incentives across EU Member States
Legal & Regulatory Framework
Charging infrastructure: Fragmented and insufficient
EU (battery) regulation: Unclear, inconsistent, and rapidly evolving
Economic Conditions
Fragmented support: EU-level ambitions vs national implementation gaps
Lack of joint vision: Member States still competing with each other, rather than positioning the EU collectively against global rivals
Funding shortfalls for scaling industrial capacity and innovation
Technology Choices
Innovation gap: EU vs Asia in battery R&D and scaling
Chemistry trade-offs: Design-to-Cost vs Design-to-Performance
Next-gen tech: Advanced Manufacturing for Advanced Chemistries
RECHARGE
BEDA


Strategic Gaps in Europe's Battery Ambition–
The 4 "S" : Scope, Scale, Speed, Sustainability
THE FOUR DIMENSIONS
SCOPE
SCALE
SPEED
SUSTAINABILITY
RECHARGE
BEDA
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Our Proposal? A Holistic Approach To Ensure The Growth Of A Robust EU Battery Ecosystem
Innovate
Produce
Innovate
Buy
Produce
Innovate
Secure
Buy
Produce
Innovate
RECHARGE
BEYA
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Main Challenges- Secure a growing industry in transition facing unfair global competition
Secure
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Main Challenges- Secure a growing industry in transition facing unfair global competition
Secure
Massive support to industry in China
IRA Effect
Value of China's battery exports to the EU and UK
A Battery Deal for Europe
RECHARGE
BEPA
18






Redox behavior
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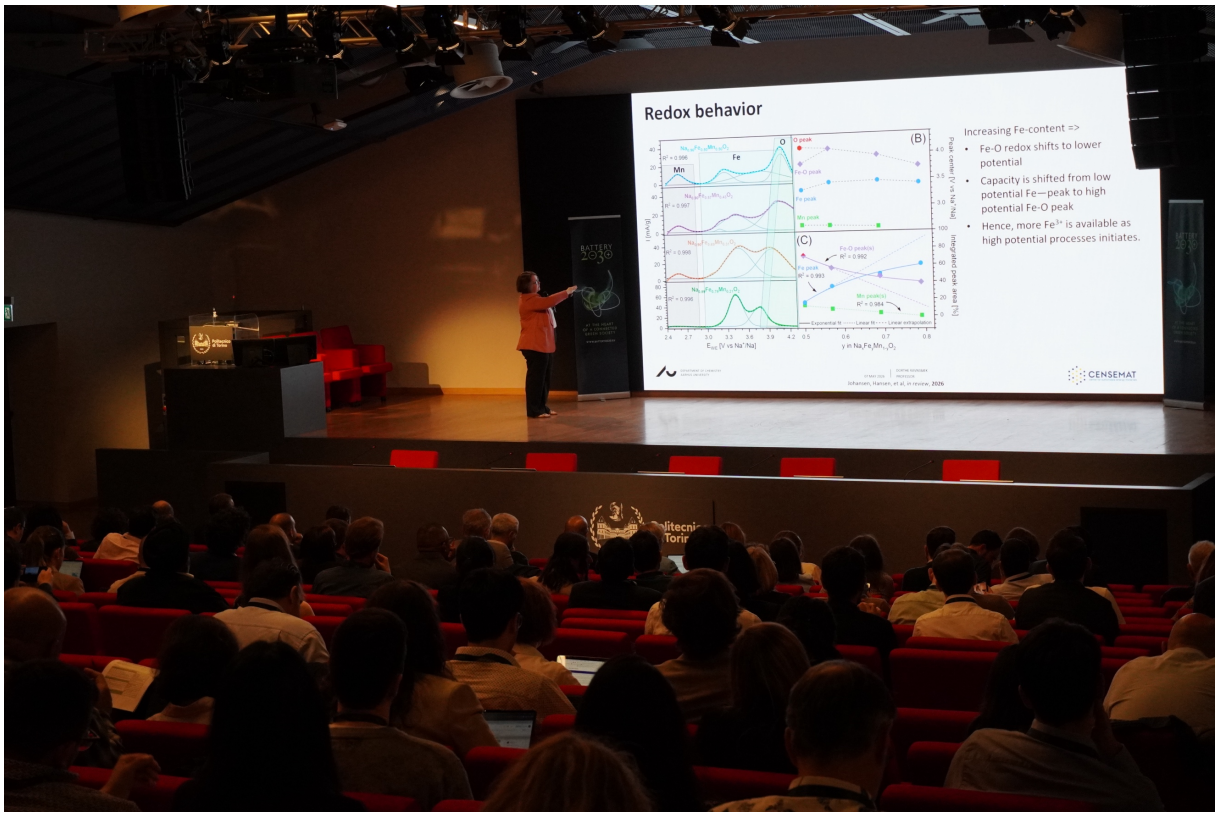
BATTERY 2030+


Redox behavior
Increasing Fe-content =>
• Fe-O redox shifts to lower potential
• Capacity is shifted from low potential Fe—peak to high potential Fe-O peak
• Hence, more Fe3+ is available as high potential processes initiates.
(B)
(C)
Mn
Fe
O
O peak
Fe-O peak
Fe peak
Mn peak
Fe-O peak(s)
Mn peak(s)
CENSEMAT
Johansen, Hansen, et al. in review, 2026
BATTERY 2030


BATTERY
2030




European commission started to enthusiastically support batteries in 2017
The European Commission launched the European Battery Alliance in October 2017.
"The annual market value is estimated at €250 billion from 2025 onwards.
For Europe, a complete domestic battery value chain is imperative for a clean energy transition and a competitive industry.
Today, EBA250 is a project-driven community which brings together more than 800 industrial and innovation actors, from mining to recycling to build a strong and competitive European battery industry."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Why?
Batteries are a key enabling technology to achieve a climate neutral society and for the safety of the society
Support the implementation of the European Green Deal, the UN Sustainable Development Goals, as well as the European Action Plan on Batteries and the SET-Plan. Later came also the Draghi report!
Complements the short-term industrial initiatives and the short to medium-term research & innovation and skills programs:
European Battery Alliance (EBA250), Batt-Bridge, The European Battery Partnership but also IPCEI and skills programs such as DESTINY, MESC, etc.
www.battery2030.eu
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Faster than expected until 2023 than a slow
down
2 x faster than we expected in 2017
Projection 2017
Actual 2023
The European Green Deal was presented in December 2019. It sets out how to make Europe the first climate-neutral continent by 2050.
www.battery2030.eu
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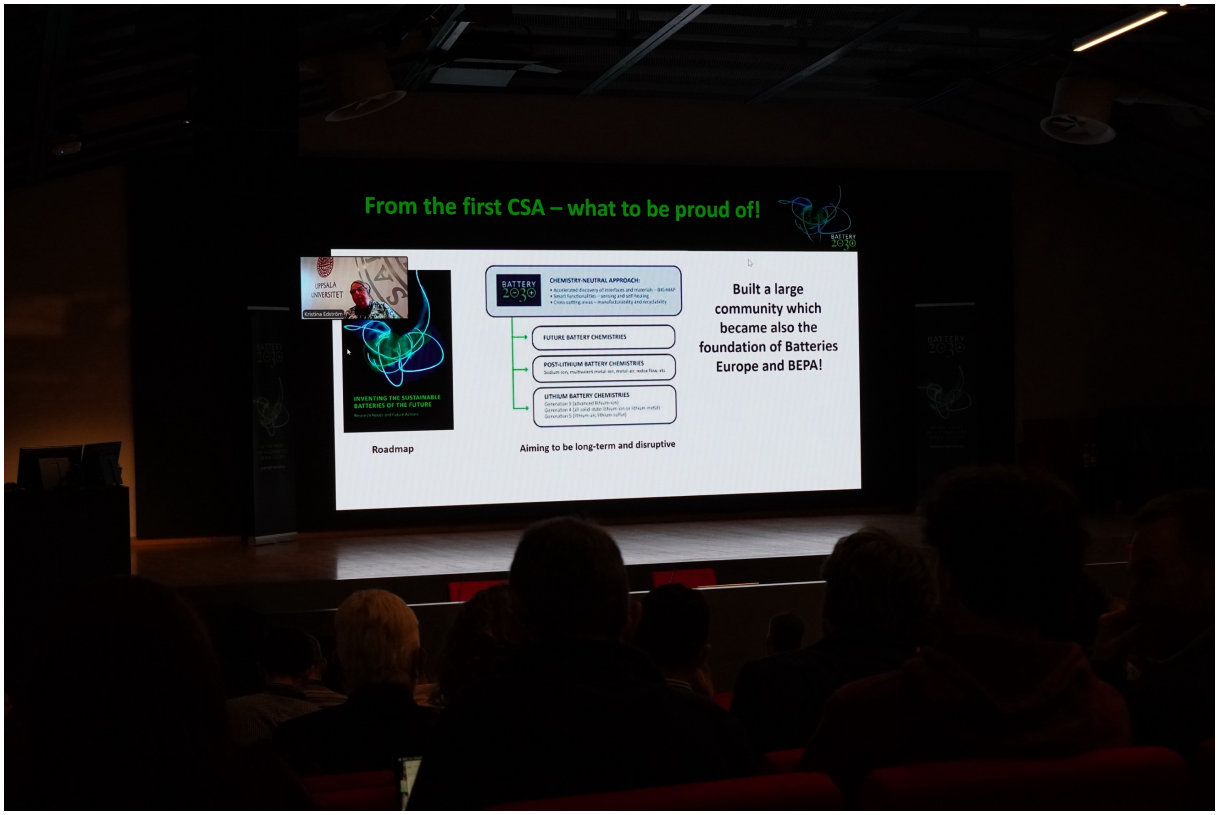
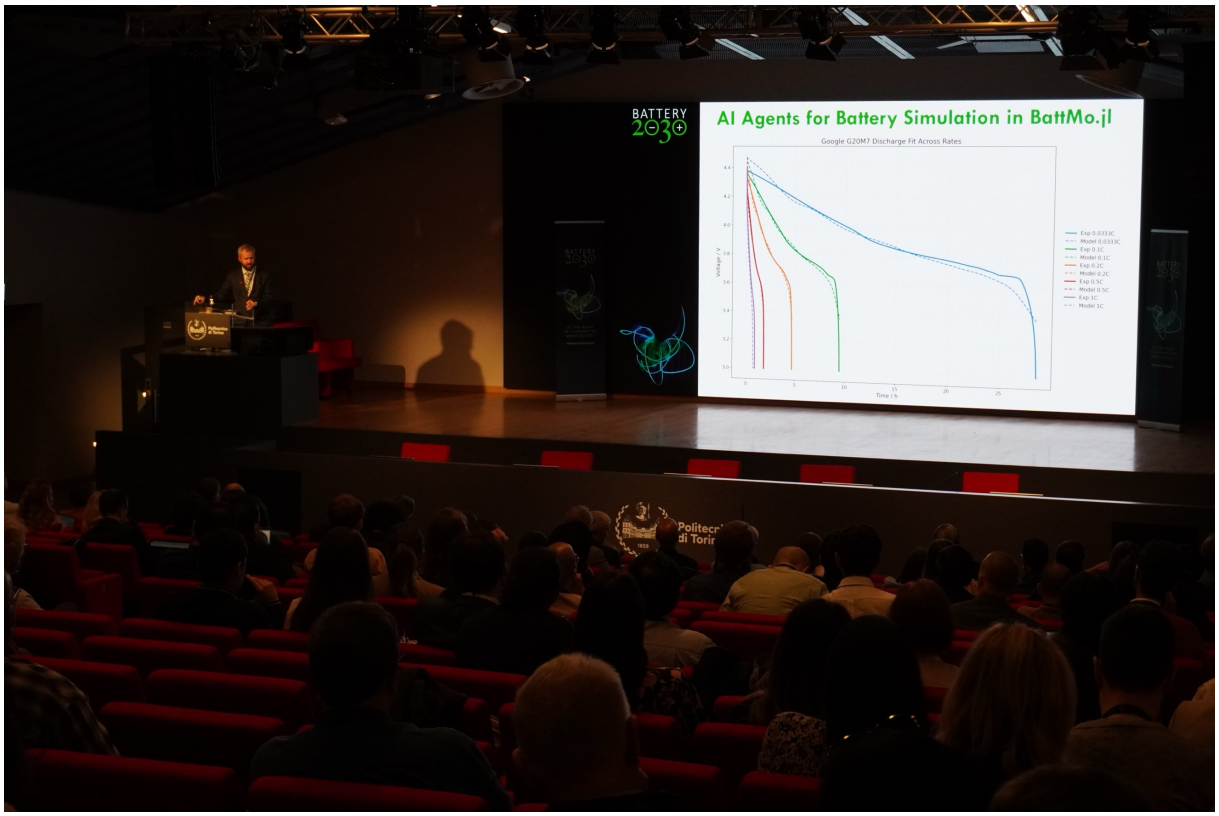

From the first CSA – what to be proud of!
UPPSALA UNIVERSITET
Kristina Edström
INVENTING THE SUSTAINABLE BATTERIES OF THE FUTURE
Roadmap
BATTERY 2030
CHEMISTRY-NEUTRAL APPROACH:
FUTURE BATTERY CHEMISTRIES
POST-LITHIUM BATTERY CHEMISTRIES
LITHIUM BATTERY CHEMISTRIES
Aiming to be long-term and disruptive
Built a large community which became also the foundation of Batteries Europe and BEPA!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AI Agents for Battery Simulation in BattMo.jl
Google G20M7 Discharge Fit Across Rates


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Join us for a symposium in beautiful Oslo!
DigiBatt Symposium on Virtual Battery Testing
June 24-25th
Register here: https://digibatt.org
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BATTERY 2030
Call to Action!
Battery research is a team effort – individually we are all good, but together we are unstoppable!
Your research data can help power discoveries for decades to come.
Adopt standards like BDF and BPX
Publish your data on Zenodo (https://zenodo.org/communities/battery-knowledge-base)
Join the discussion! https://bda.discourse.group/
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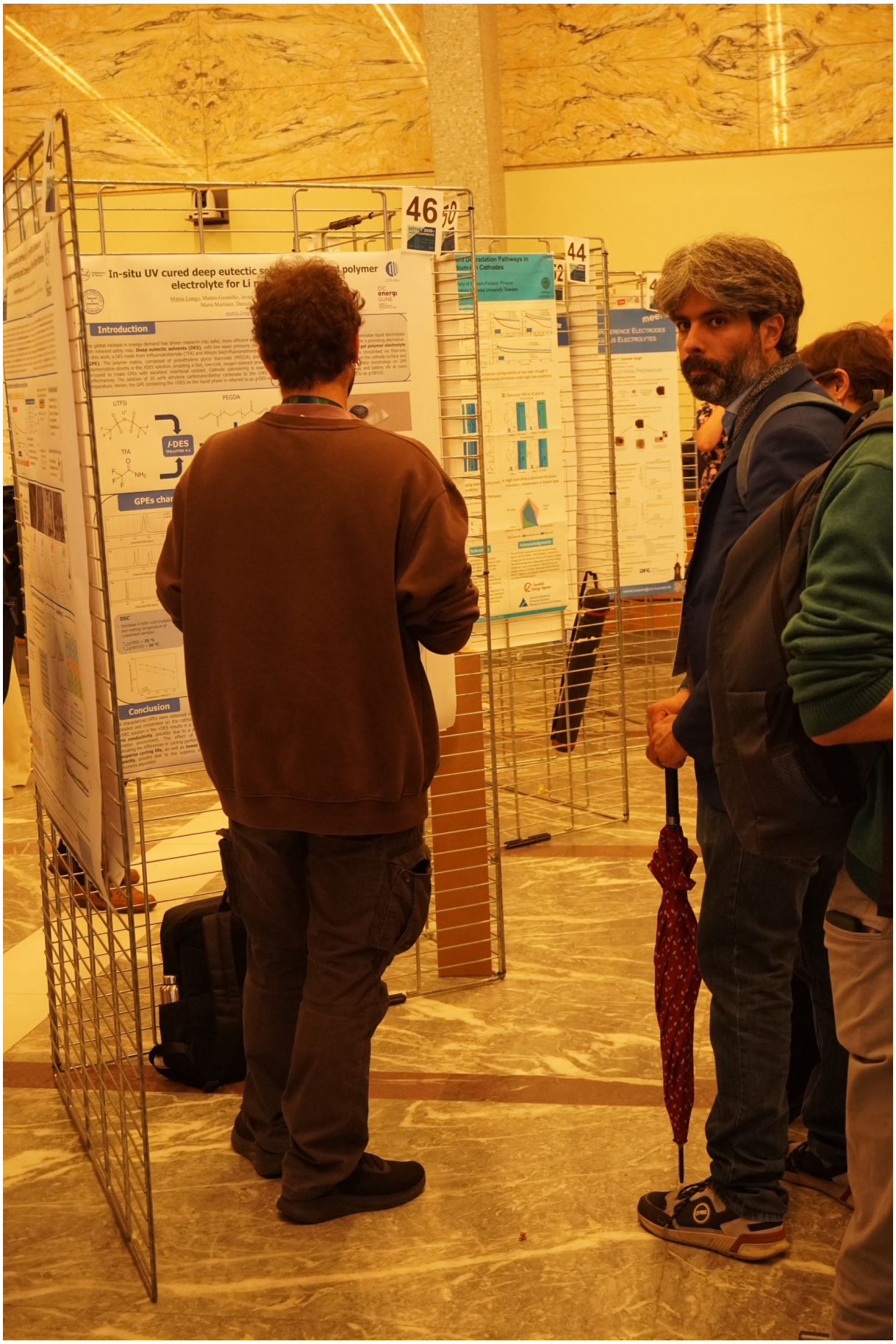
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Introduction
Conclusion
LITFSI
PEGDA
TFA
DSC


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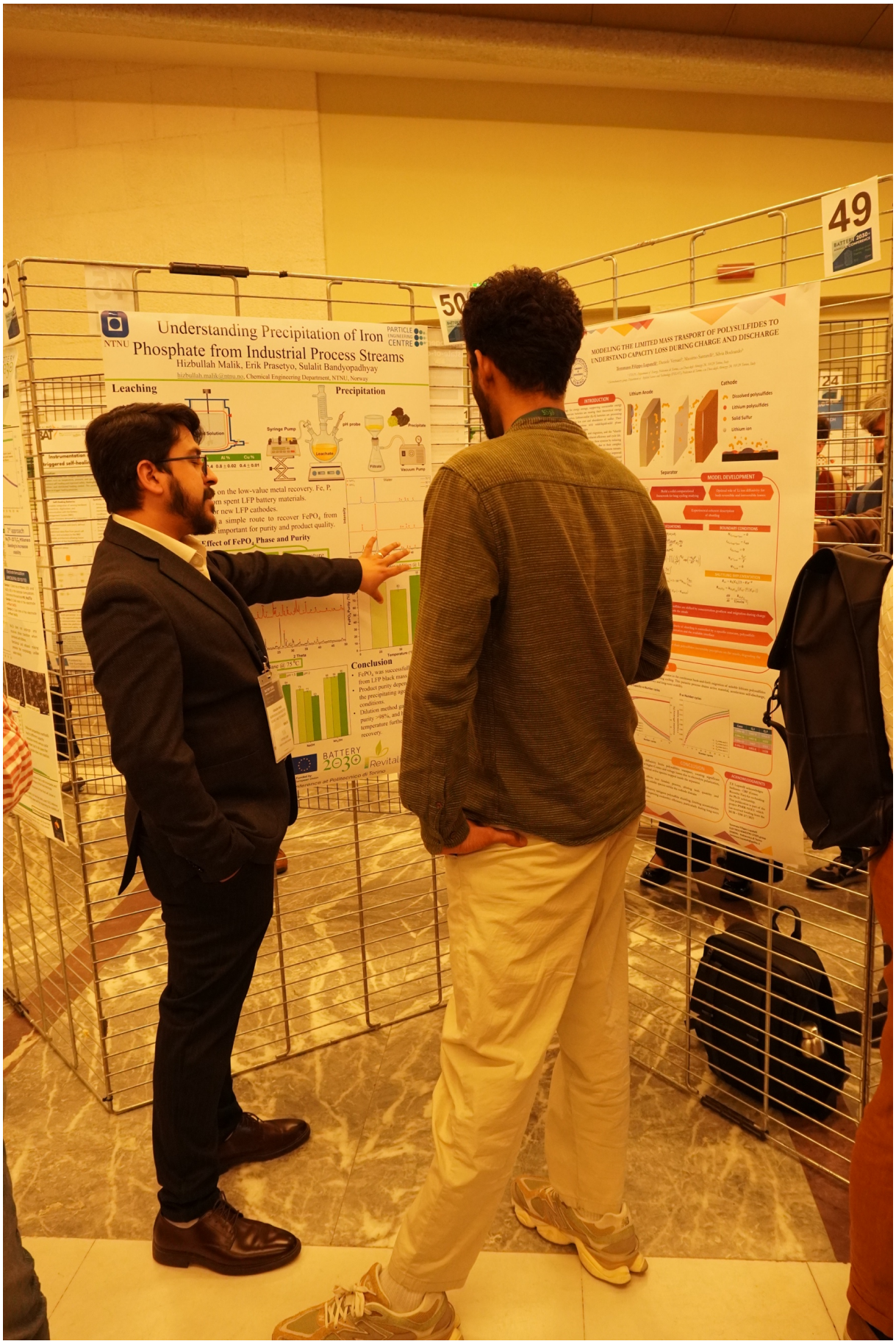
theoretical studies of biomass-derived
carbons for Li–s batteries
Methodology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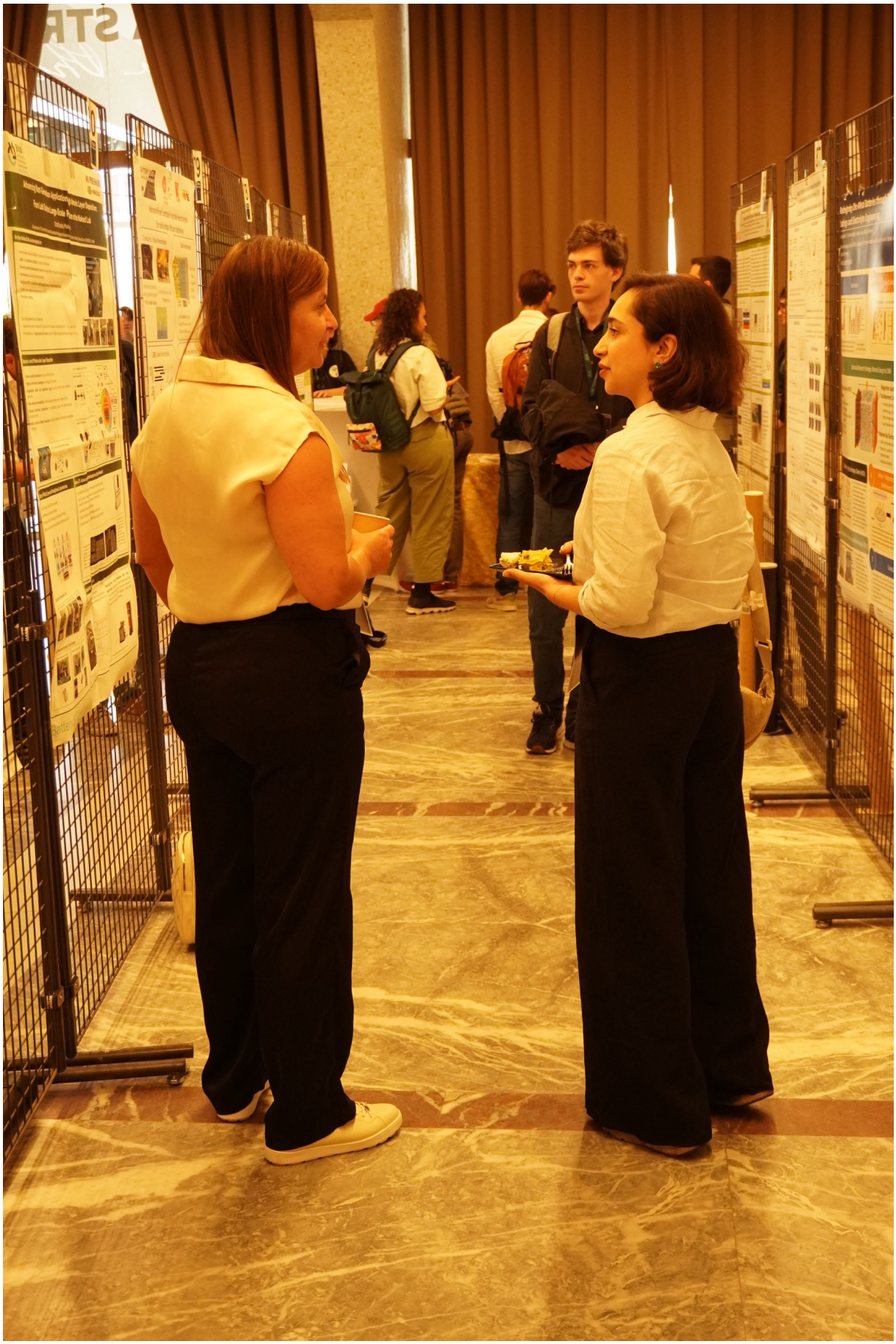
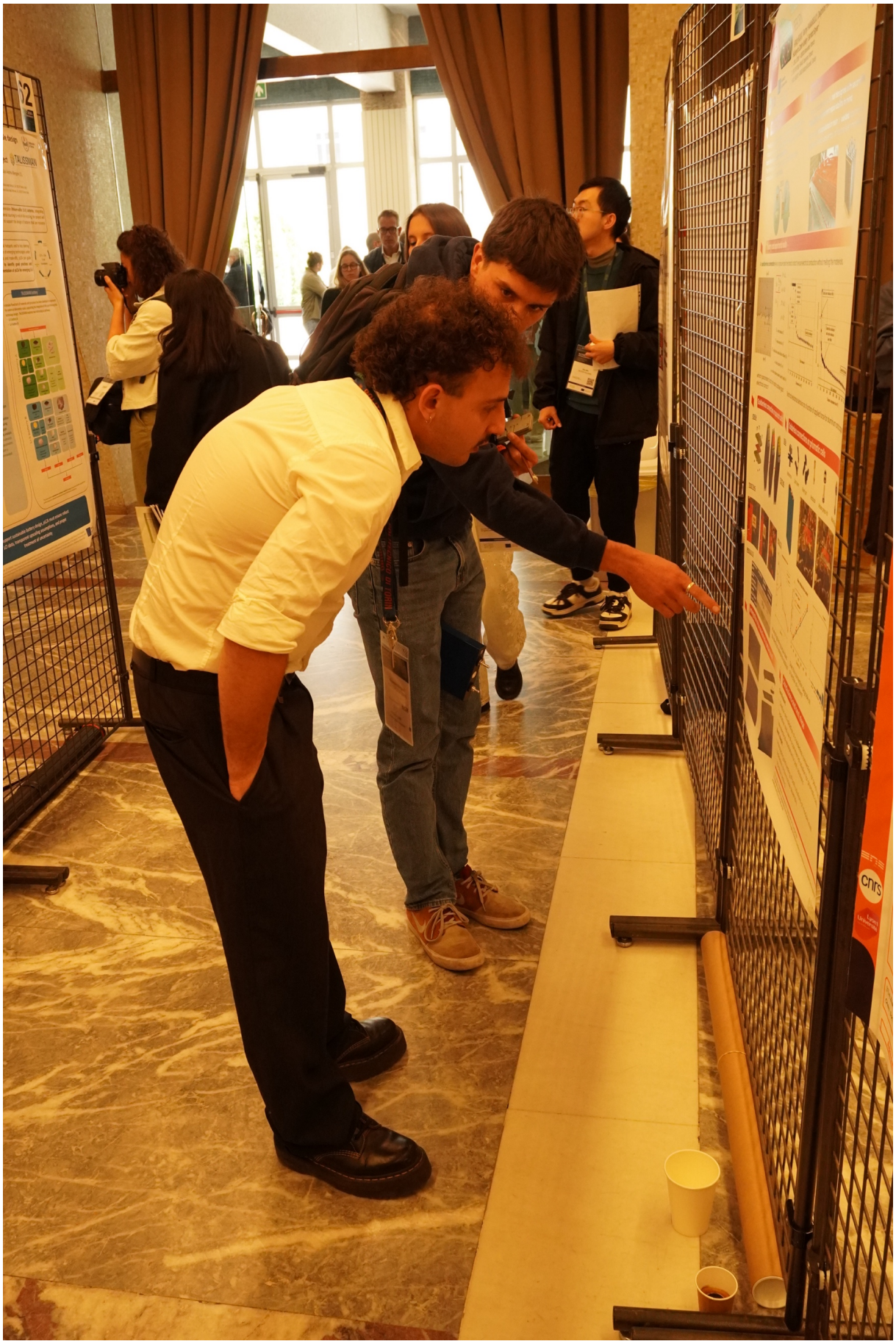
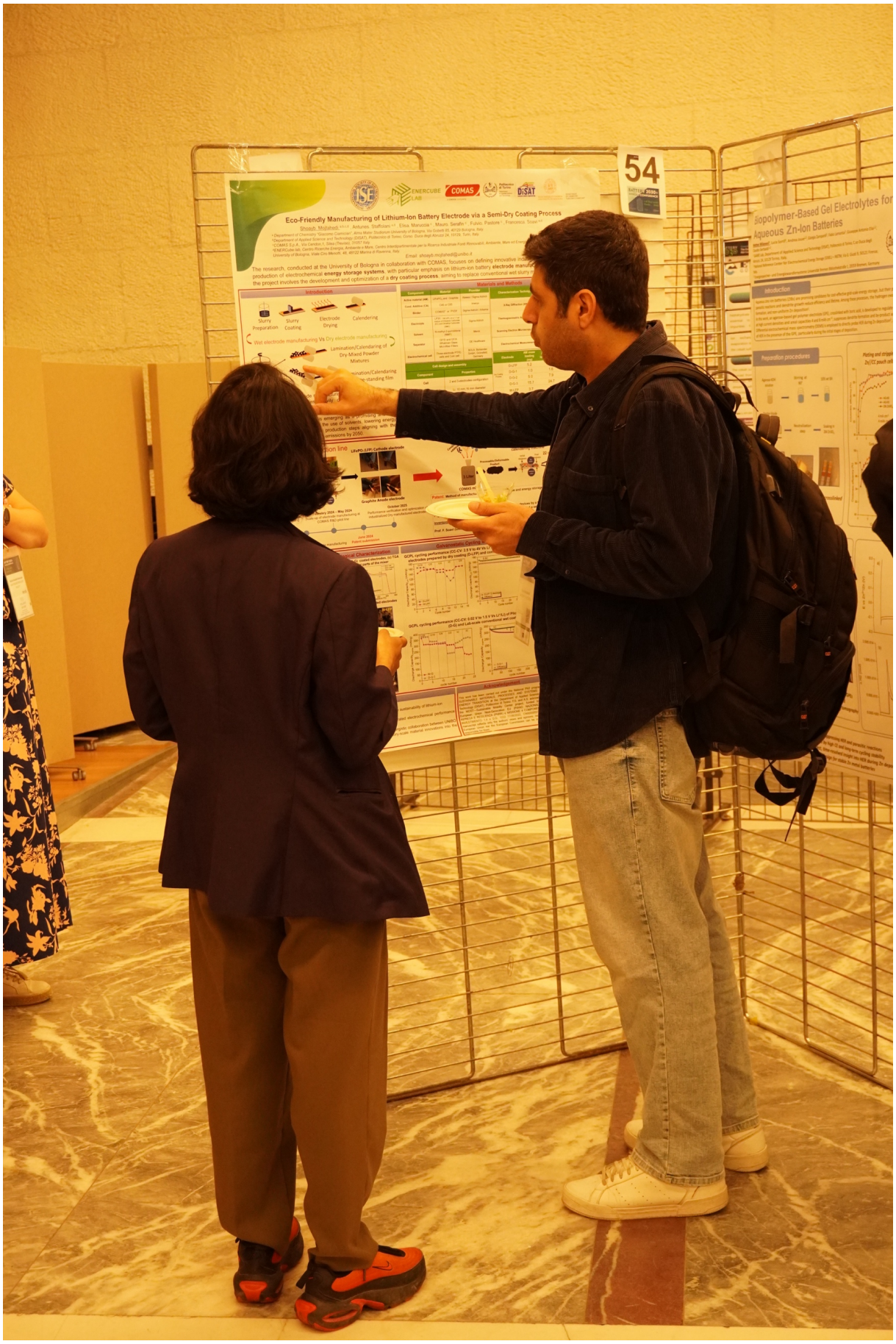
Understanding Precipitation of Iron Phosphate from Industrial Process Streams
Hizbullah Malik, Erik Prasetyo, Sulalit Bandyopadhyay
hizbullah.malik@ntnu.no, Chemical Engineering Department, NTNU, Norway
NTNU
PARTICLE ENGINEERING CENTRE
Leaching
Precipitation
Conclusion
BATTERY 2030
MODELING THE LIMITED MASS TRASPORT OF POLYSULFIDES TO UNDERSTAND CAPACITY LOSS DURING CHARGE AND DISCHARGE
Lithium Anode
Cathode
Separator
Dissolved polysulfides
Lithium polysulfides
Solid Sulfur
Lithium ion
MODEL DEVELOPMENT




TALISMAN
cnrs

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Eco-Friendly Manufacturing of Lithium-Ion Battery Electrode via a Semi-Dry Coating Process
Introduction
Slurry Preparation
Slurry Coating
Electrode Drying
Calendering
Wet electrode manufacturing Vs Dry electrode manufacturing
Lamination/Calendaring of Dry-Mixed Powder Mixtures
Materials and Methods
Biopolymer-Based Gel Electrolytes for Aqueous Zn-Ion Batteries
Introduction
Preparation procedures


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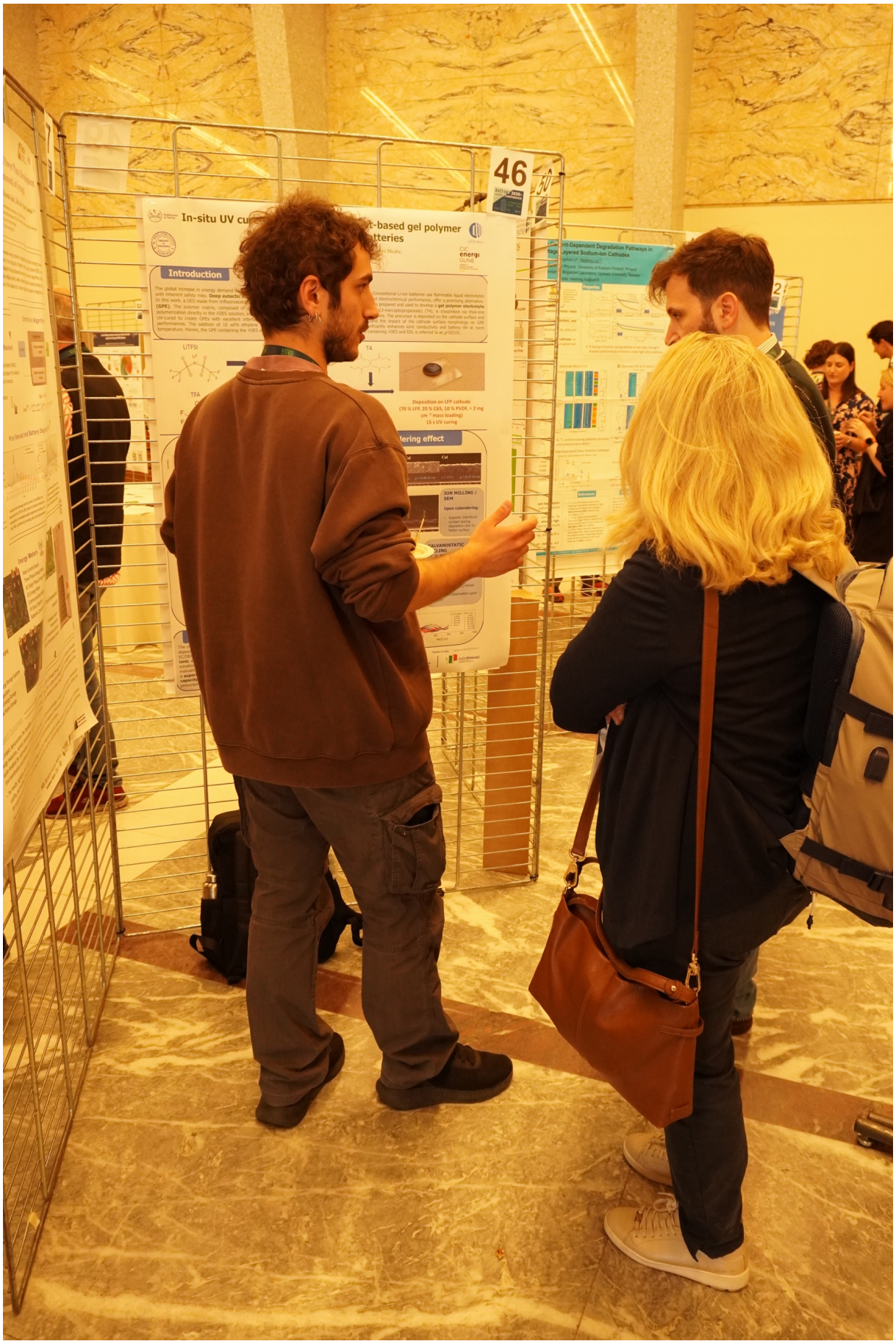
Scale Modeling

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Introduction
Deposition on LFP cathode
ION MILLING / SEM
Upon calendering


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Understanding Precipitation of Iron Phosphate from Industrial Process Streams
Hizbullah Malik, Erik Prasetyo, Sulalit Bandyopadhyay
NTNU
PARTICLE TECHNOLOGY CENTRE
Leaching
Background
Results
BATTERY 2030+


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Metal Sulphides for
thium-Sulphur Batteries
DiSAT
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Computational Search of Na ion Halide Electrolytes for Battery Applications
Intro
Methods
Results
Conclusions
Bibliography
Acknowledgment









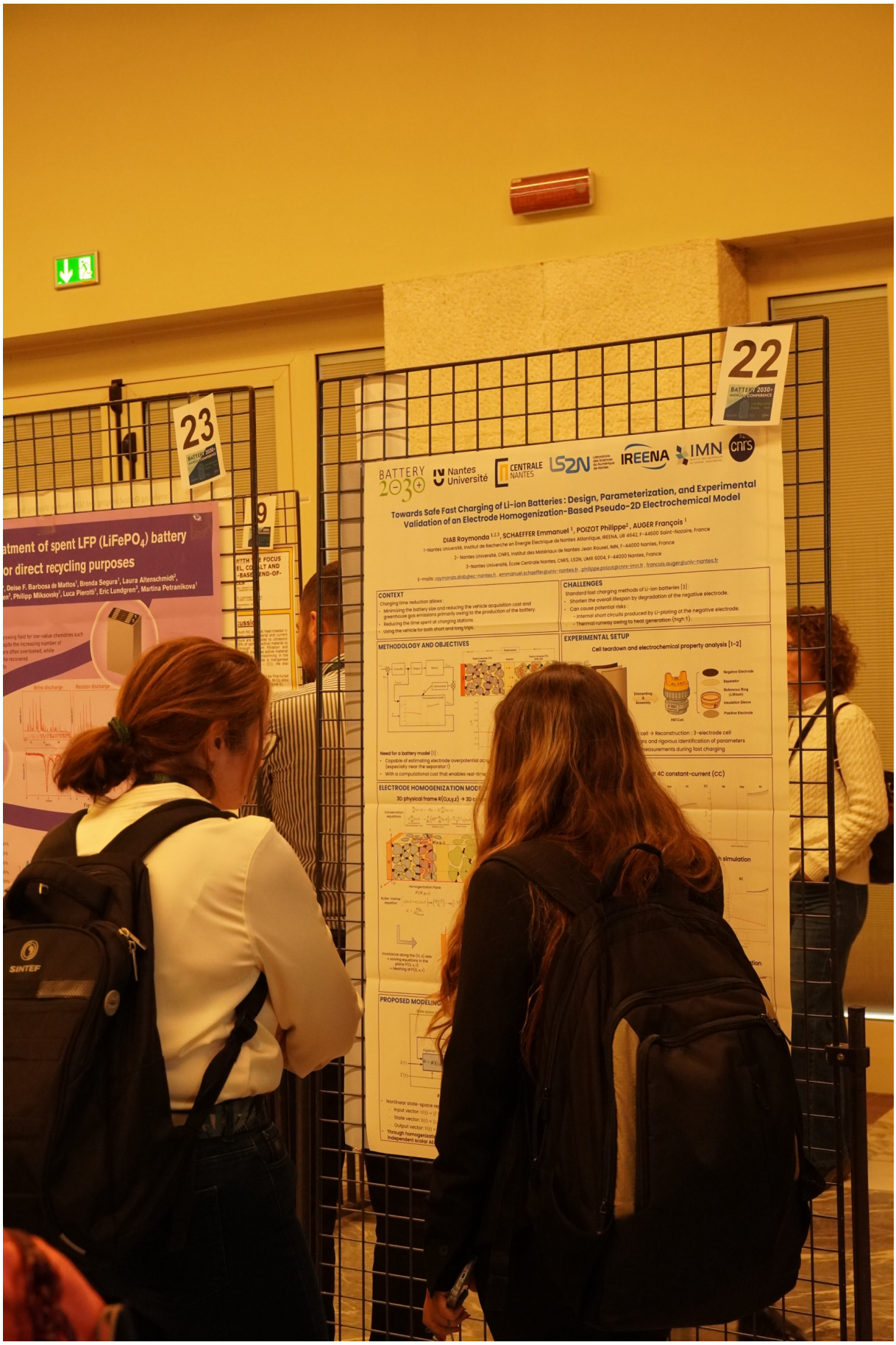





TOILETTE
STAFF


BATTERY 2030+
Jonah Blume Kemkes
UNIVERSITY OF BOLOGNA
VOTING CARD
CHECK OUT
OUR WEBSI
BATTERY
INNOVATION
DAYS

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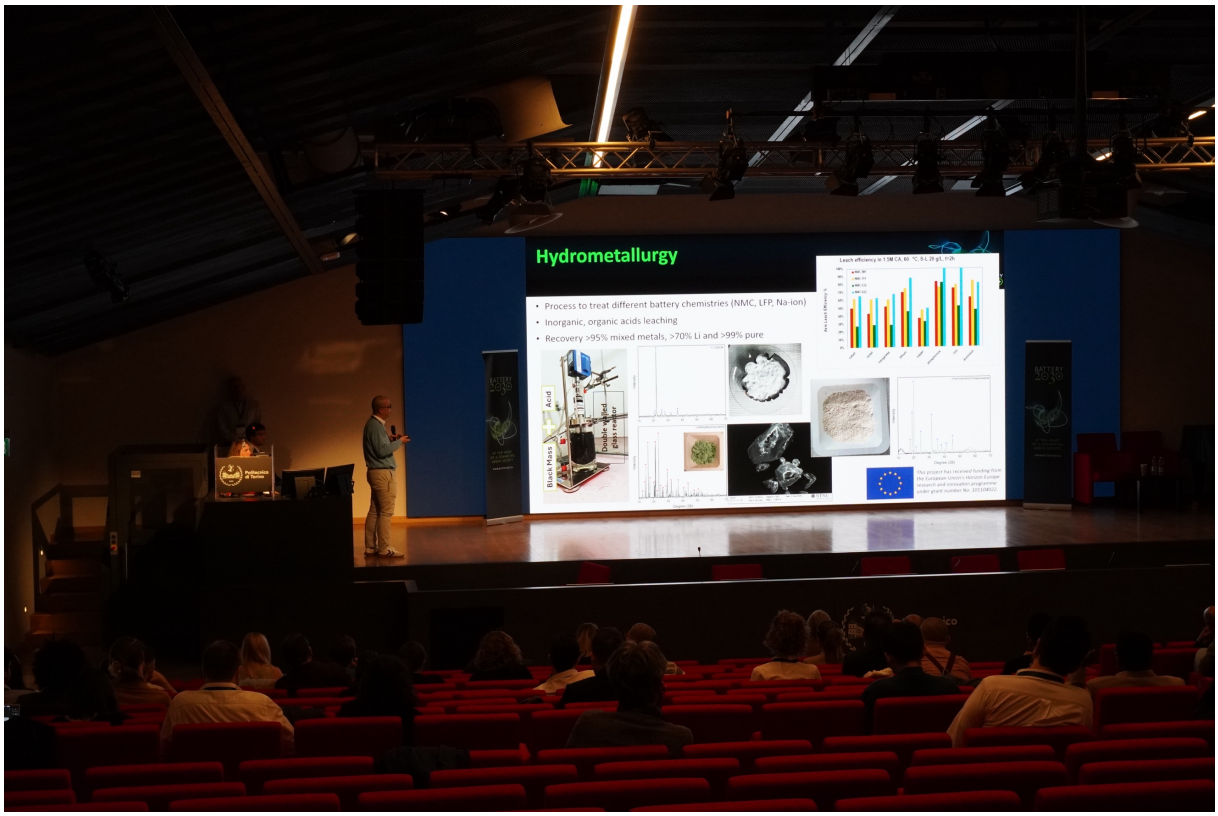
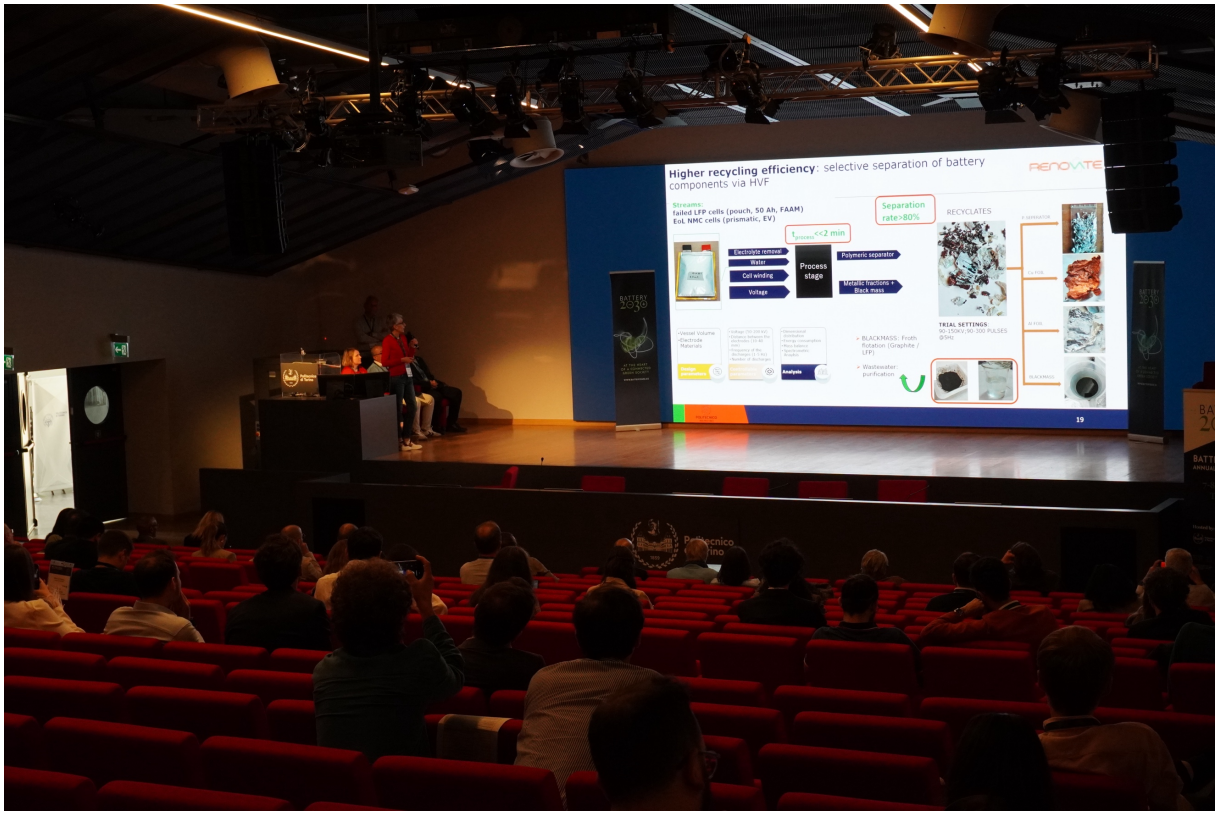
Towards Safe Fast Charging of Li-ion Batteries : Design, Parameterization, and Experimental Validation of an Electrode Homogenization-Based Pseudo-2D Electrochemical Model
DIAB Raymonda [1,2,3], SCHAEFFER Emmanuel [1], POIZOT Philippe[2], AUGER François [1]
CONTEXT
CHALLENGES
METHODOLOGY AND OBJECTIVES
EXPERIMENTAL SETUP
Cell teardown and electrochemical property analysis [1-2]
ELECTRODE HOMOGENIZATION MODEL
PROPOSED MODELING
or direct recycling purposes
SINTEF


Hydrometallurgy
• Process to treat different battery chemistries (NMC, LFP, Na-ion)
• Inorganic, organic acids leaching
• Recovery >95% mixed metals, >70% Li and >99% pure
Black Mass
Acid
Double-walled glass reactor


Higher recycling efficiency: selective separation of battery components via HVF
RENOVATE
Streams:
failed LFP cells (pouch, 50 Ah, FAAM)
EoL NMC cells (prismatic, EV)
Separation rate>80%
RECYCLATES
Electrolyte removal
Plate
Coil winding
Voltage
Process stage
Polymeric separator
Metallic fractions + Black mass
TRIAL SETTINGS:
BLACKMASS: Froth flotation (Graphite / LFP)
Wastewater purification
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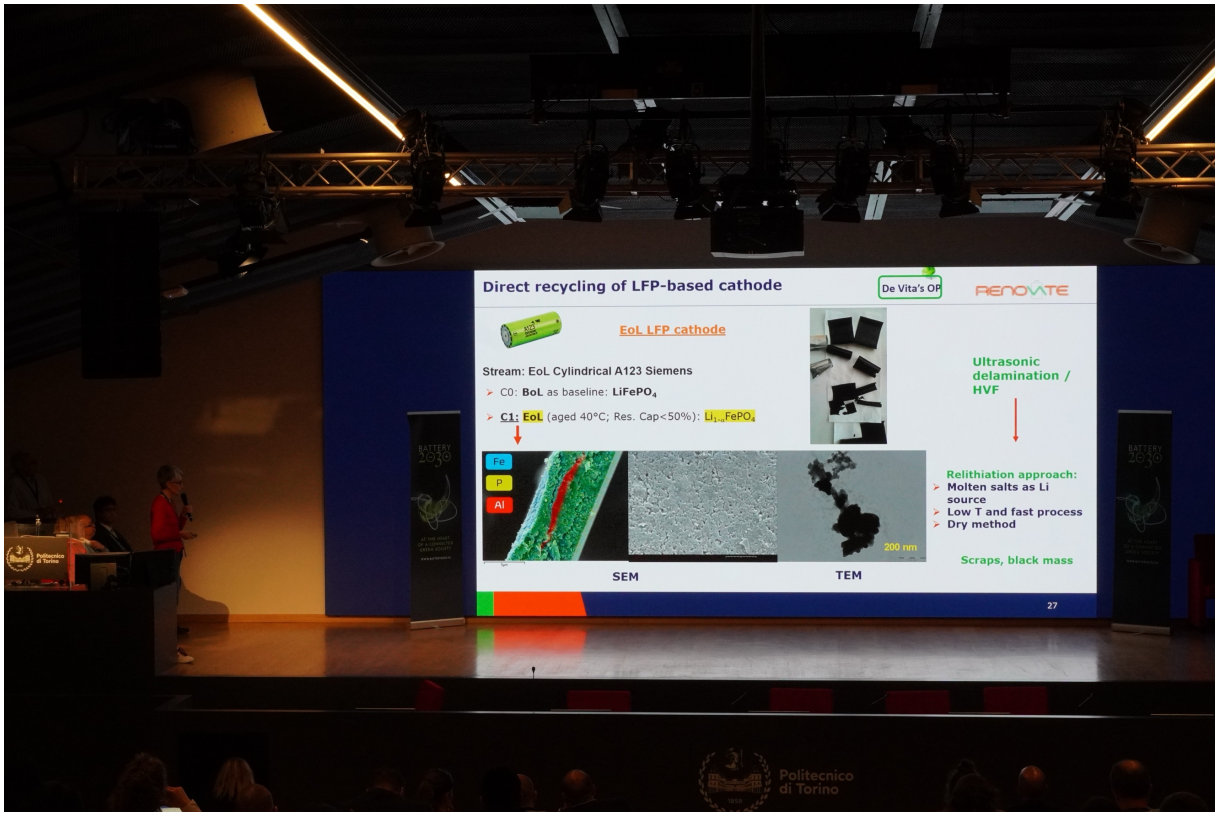
Higher recycling value chain overall profitability by recovering non-CAM valuable materials: 1) electrolyte
RENOVATE
1) Supercritical Fluid Extraction
2) Thermal method
Scrap
EoL
Carbonates and additives
(GC-MS)
LiPF6
(ICP/XRD/SAXS)


Direct recycling of LFP-based cathode
De Vita's OP
RENOVATE
EoL LFP cathode
Stream: EoL Cylindrical A123 Siemens
C0: BoL as baseline: LiFePO4
C1: EoL (aged 40°C; Res. Cap<50%): Li1-xFePO4
Ultrasonic delamination / HVF
Fe
P
Al
200 nm
SEM
TEM
Relithiation approach:
Molten salts as Li source
Low T and fast process
Dry method
Scraps, black mass
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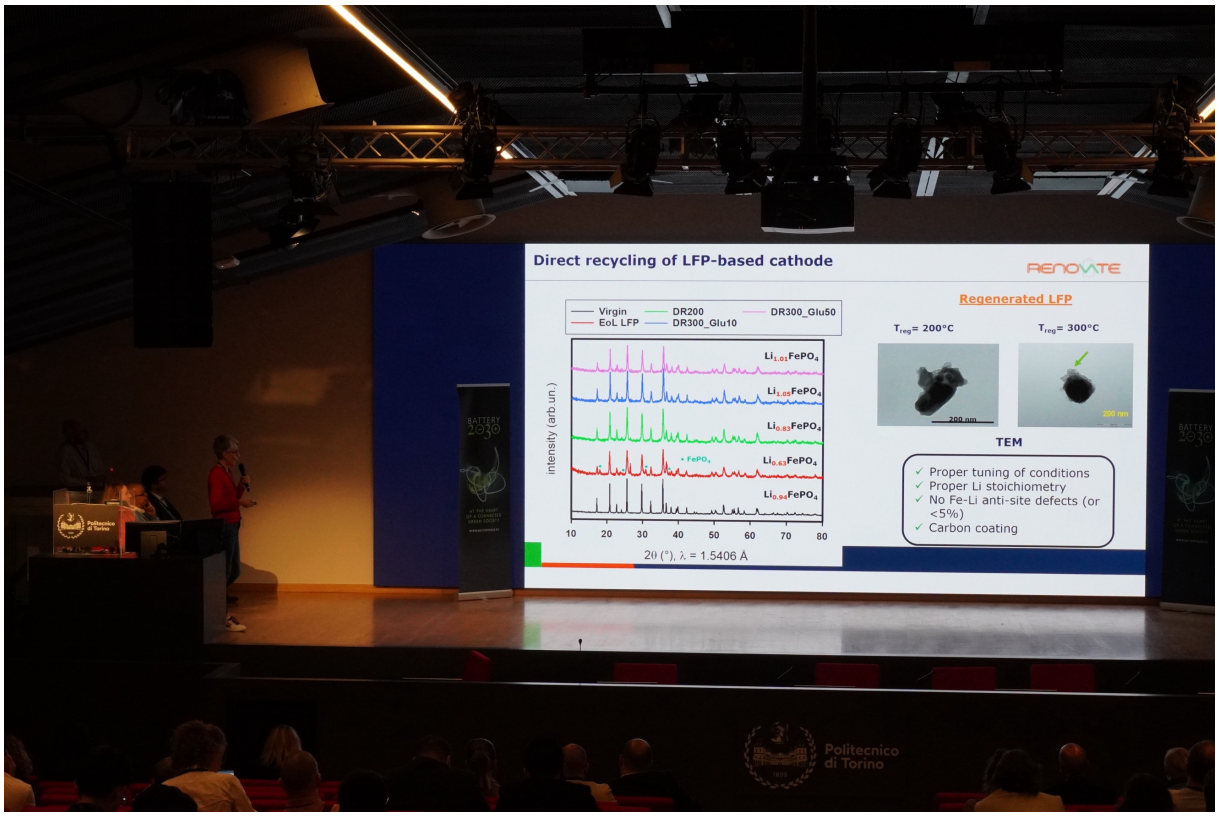
Direct recycling of LFP-based cathode
RENOVATE
Virgin
EoL LFP
DR200
DR300_Glu10
DR300_Glu50
intensity (arb.un.)
10 20 30 40 50 60 70 80
2θ (°), λ = 1.5406 Å
Regenerated LFP
T_reg= 200°C
T_reg= 300°C
200 nm
TEM
✓ Proper tuning of conditions
✓ Proper Li stoichiometry
✓ No Fe-Li anti-site defects (or <5%)
✓ Carbon coating
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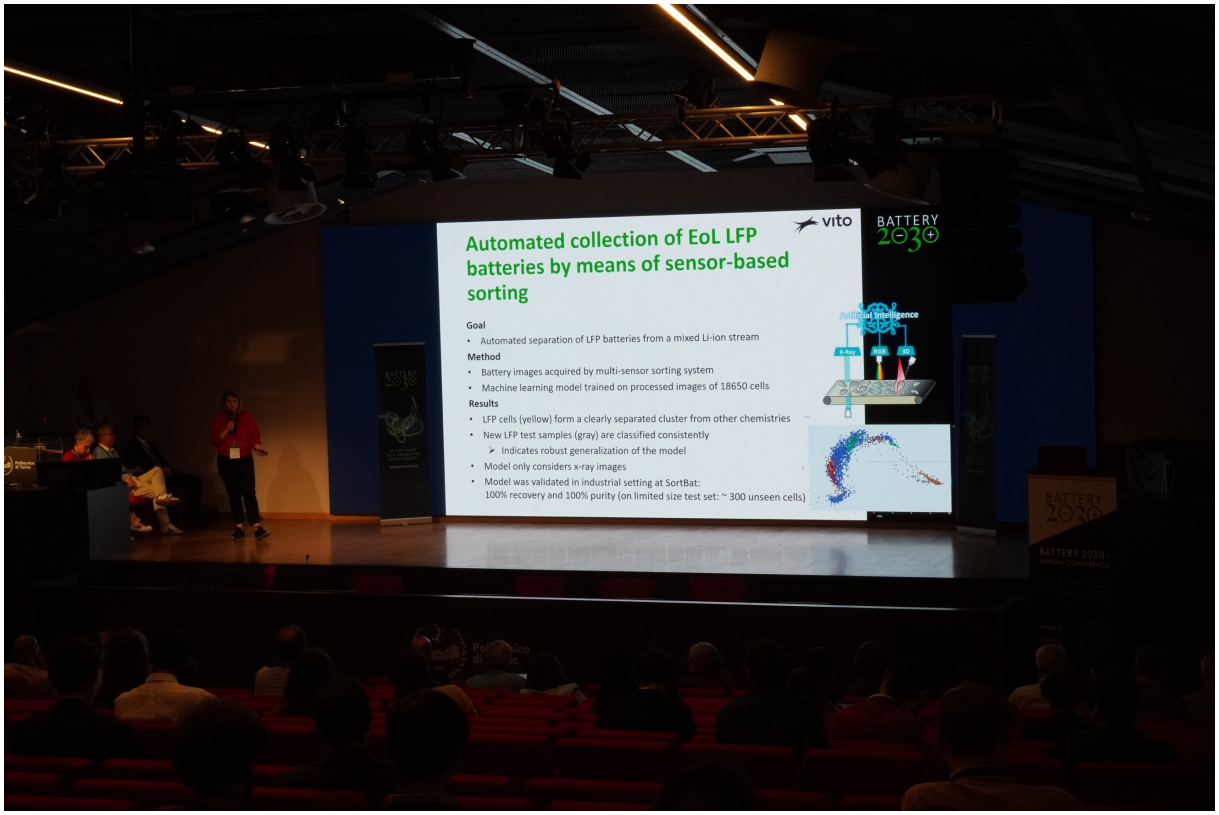
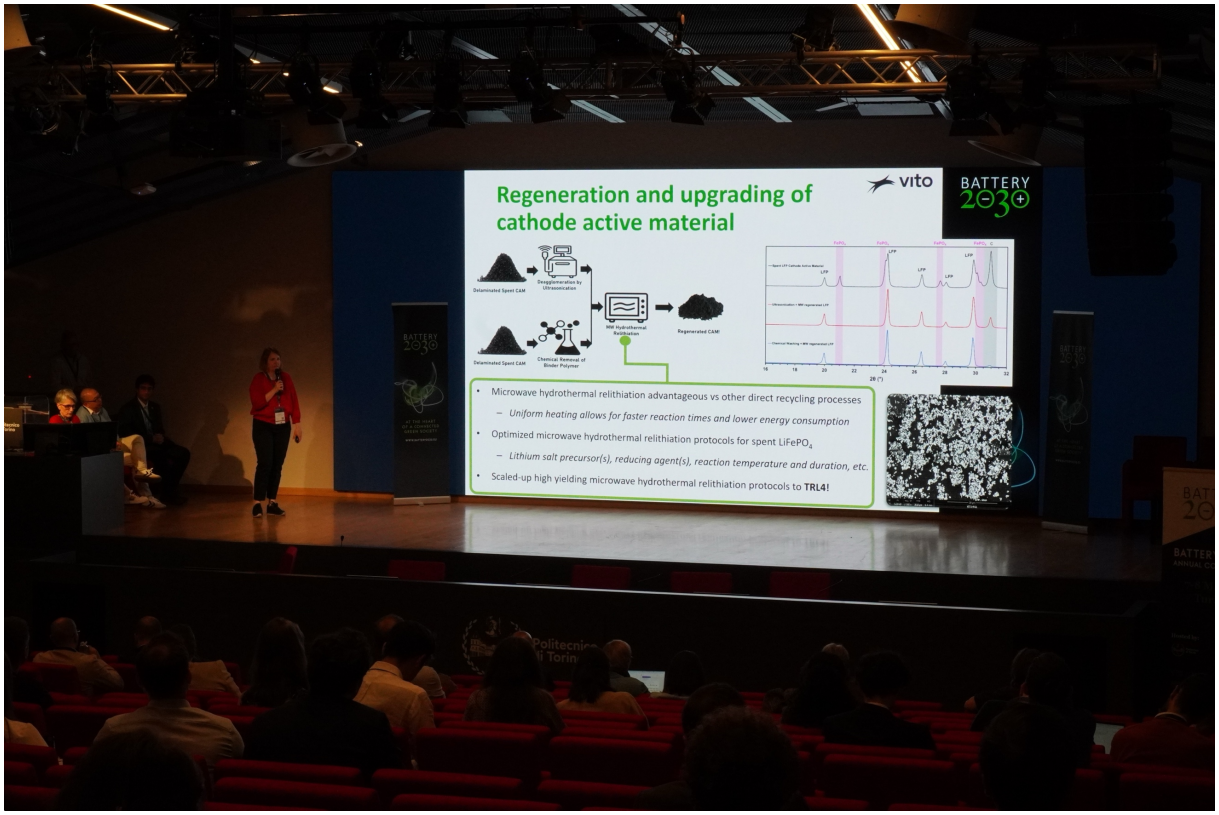

Automated collection of EoL LFP batteries by means of sensor-based sorting
vito
BATTERY 2030+
Goal
• Automated separation of LFP batteries from a mixed Li-ion stream
Method
• Battery images acquired by multi-sensor sorting system
• Machine learning model trained on processed images of 18650 cells
Results
• LFP cells (yellow) form a clearly separated cluster from other chemistries
• New LFP test samples (gray) are classified consistently
➢ Indicates robust generalization of the model
• Model only considers x-ray images
• Model was validated in industrial setting at SortBat:
100% recovery and 100% purity (on limited size test set: ~ 300 unseen cells)
Artificial Intelligence
X-Ray
RGB
3D


Automated cell disassembly
Fraunhofer ISC
BATTERY 2030+


Regeneration and upgrading of cathode active material
vito
BATTERY 2030+
Delaminated Spent CAM
Deagglomeration by Ultrasonication
Chemical Removal of Binder Polymer
MW Hydrothermal Relithiation
Regenerated CAM
LFP
2θ (°)
Microwave hydrothermal relithiation advantageous vs other direct recycling processes
Uniform heating allows for faster reaction times and lower energy consumption
Optimized microwave hydrothermal relithiation protocols for spent $LiFePO_4$
Lithium salt precursor(s), reducing agent(s), reaction temperature and duration, etc.
Scaled-up high yielding microwave hydrothermal relithiation protocols to TRL4!


Methodology
The CIRCUBATT Roadmap: Building Viable BaaS Revenue Models
A structured mixed-methods approach combining technical data with expert co-creation to bridge the gap between academic theory and commercial reality. The derivation of revenue pathways relies on a rigorous filtering and validation process to ensure technical and economic feasibility.
1. Filter via Technical Screening
Evaluated lithium-ion characteristics to exclude high-risk, high-degradation application domains.
2. Engage Stakeholder Co-Creation
Conducted focus groups with 18 value-chain experts to refine technically feasible applications.
3. Identify Structural Market Frictions
Analyzed focus group transcripts to isolate financial, regulatory, and volatility-related commercial barriers.
Value Realisation Interface
Asset Deployment Architecture
4. Map Key Classification Dimensions
Intersected "Value Realisation Interface" and "Asset Deployment Architecture" to define four distinct pathways.
5. Conduct Final Cross-Validation
Ratified results through social life cycle assessments and expert elicitation to ensure long-term robustness.
Source: Li Zhou, Jimmy Nguyen, James Duong, Maggie Xu, Hetty Sun


Methodology
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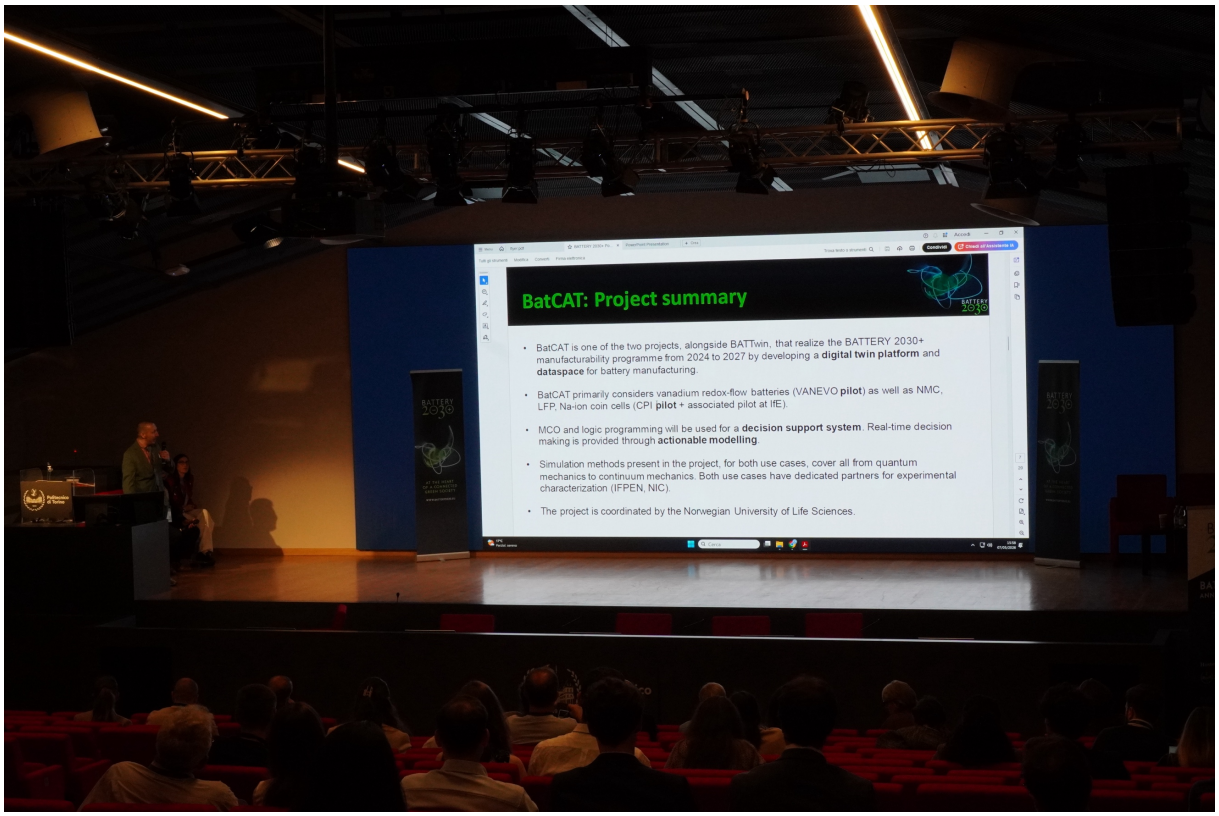
BatCAT: Project summary
BatCAT is one of the two projects, alongside BATTwin, that realize the BATTERY 2030+ manufacturability programme from 2024 to 2027 by developing a digital twin platform and dataspace for battery manufacturing.
BatCAT primarily considers vanadium redox-flow batteries (VANEVO pilot) as well as NMC, LFP, Na-ion coin cells (CPI pilot + associated pilot at IfE).
MCO and logic programming will be used for a decision support system. Real-time decision making is provided through actionable modelling.
Simulation methods present in the project, for both use cases, cover all from quantum mechanics to continuum mechanics. Both use cases have dedicated partners for experimental characterization (IFPEN, NIC).
The project is coordinated by the Norwegian University of Life Sciences.


Manufacturability: STELLAR project
STELLAR Big Picture Goals
STELLAR PROJECT


Manufacturability: STELLAR project
STELLAR Big Picture Goals
STELLAR PROJECT


Manufacturability: STELLAR project
STELLAR Big Picture Goals
STELLAR PROJECT


BatCAT: Simulation campaigns
VANEVO
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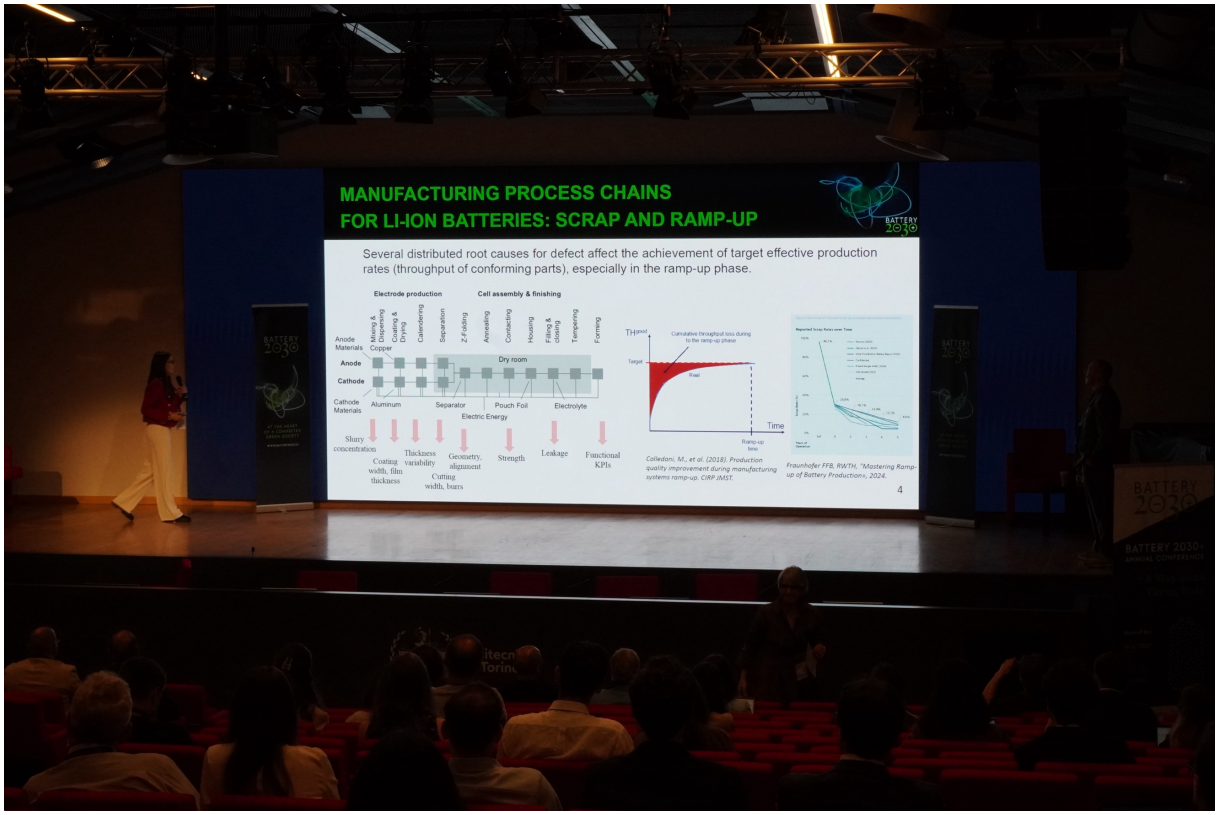
MANUFACTURING PROCESS CHAINS
FOR LI-ION BATTERIES: SCRAP AND RAMP-UP
Several distributed root causes for defect affect the achievement of target effective production rates (throughput of conforming parties), especially in the ramp-up phase.
Electrode production
Cell assembly & finishing
Anode Materials
Mixing & Dispersing
Coating & Drying
Calendering
Separation
Z-Folding
Annealing
Contacting
Housing
Filling & Closing
Tempering
Forming
Copper
Anode
Dry room
Cathode
Cathode Materials
Aluminum
Separator
Pouch Foil
Electrolyte
Electric Energy
Slurry concentration
Coating width, film thickness
Thickness variability
Cutting width, burrs
Geometry, alignment
Strength
Leakage
Functional KPIs
Cumulative throughput loss during to the ramp-up phase
Target
Real
Time
Ramp-up time
Colledani, M., et al. (2018). Production quality improvement during manufacturing systems ramp-up. CIRP JMST.
Fraunhofer FFB, RWTH, "Mastering Ramp-up of Battery Productions, 2024.
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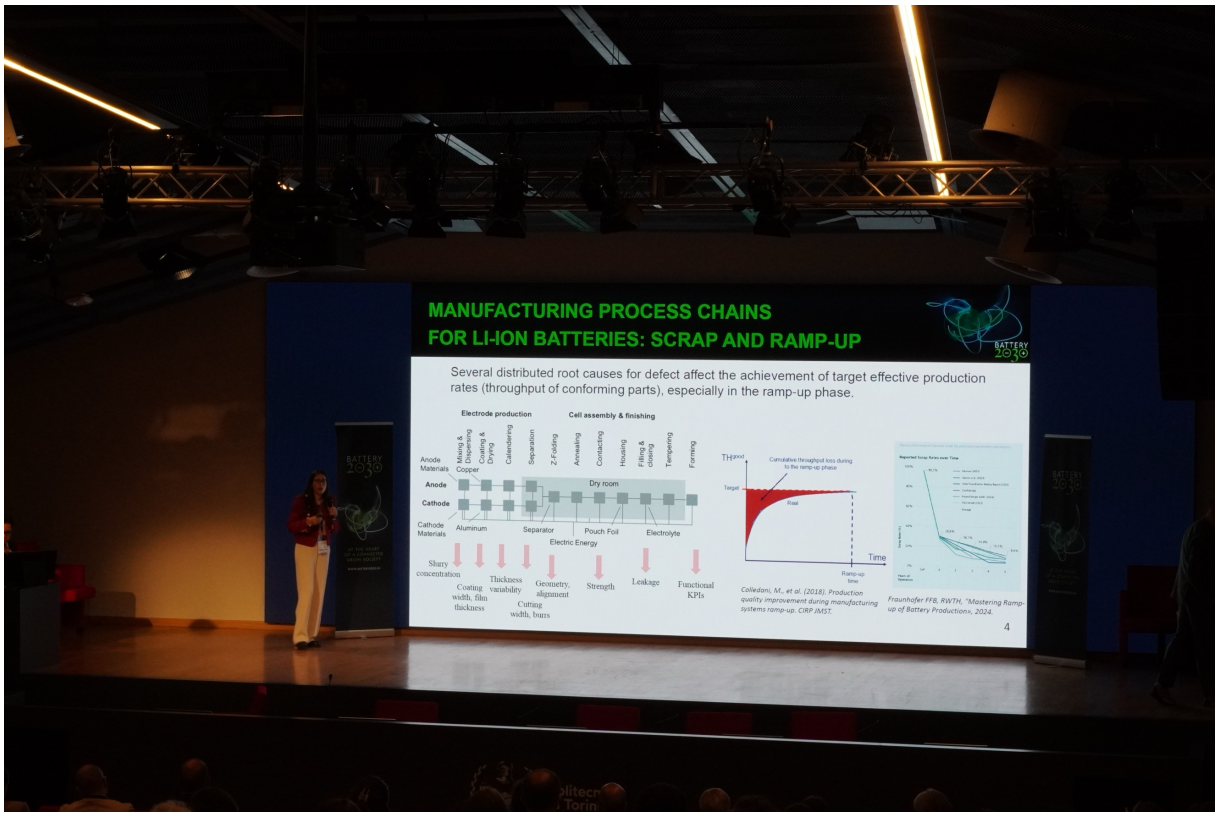
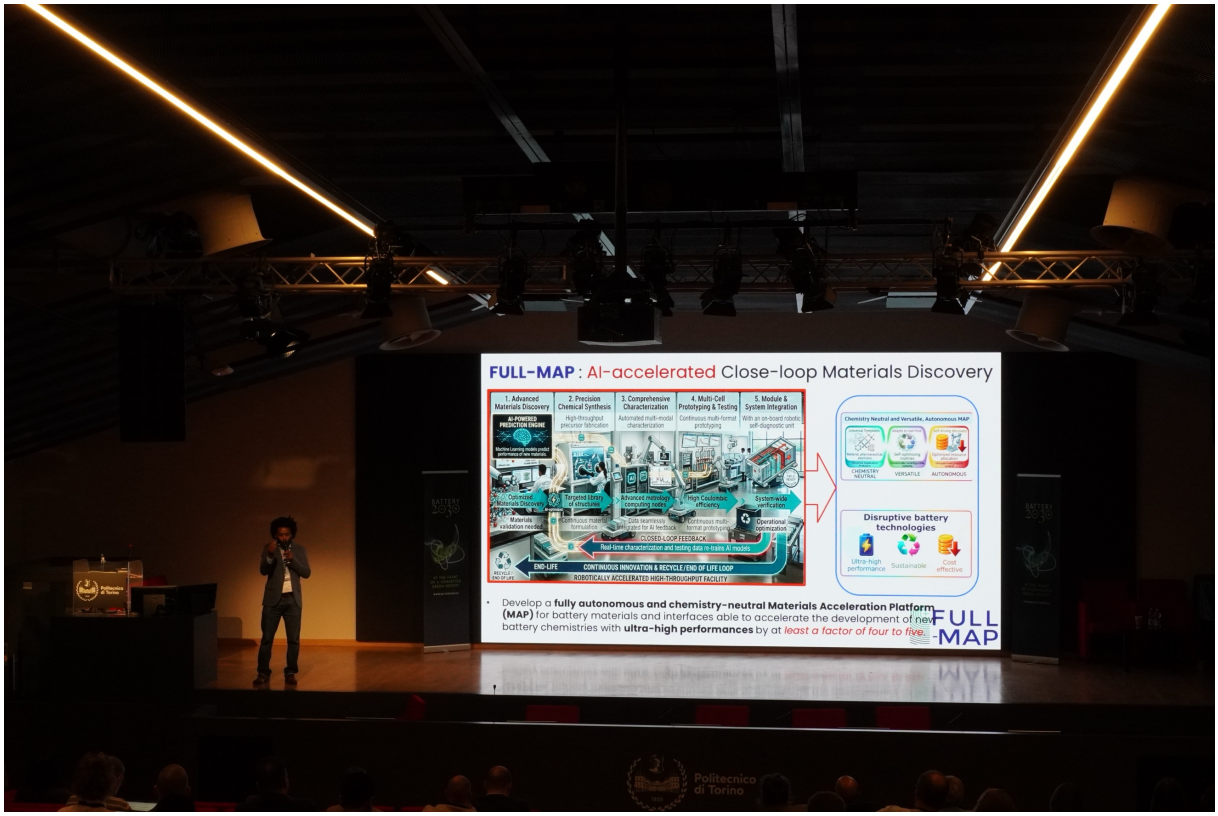
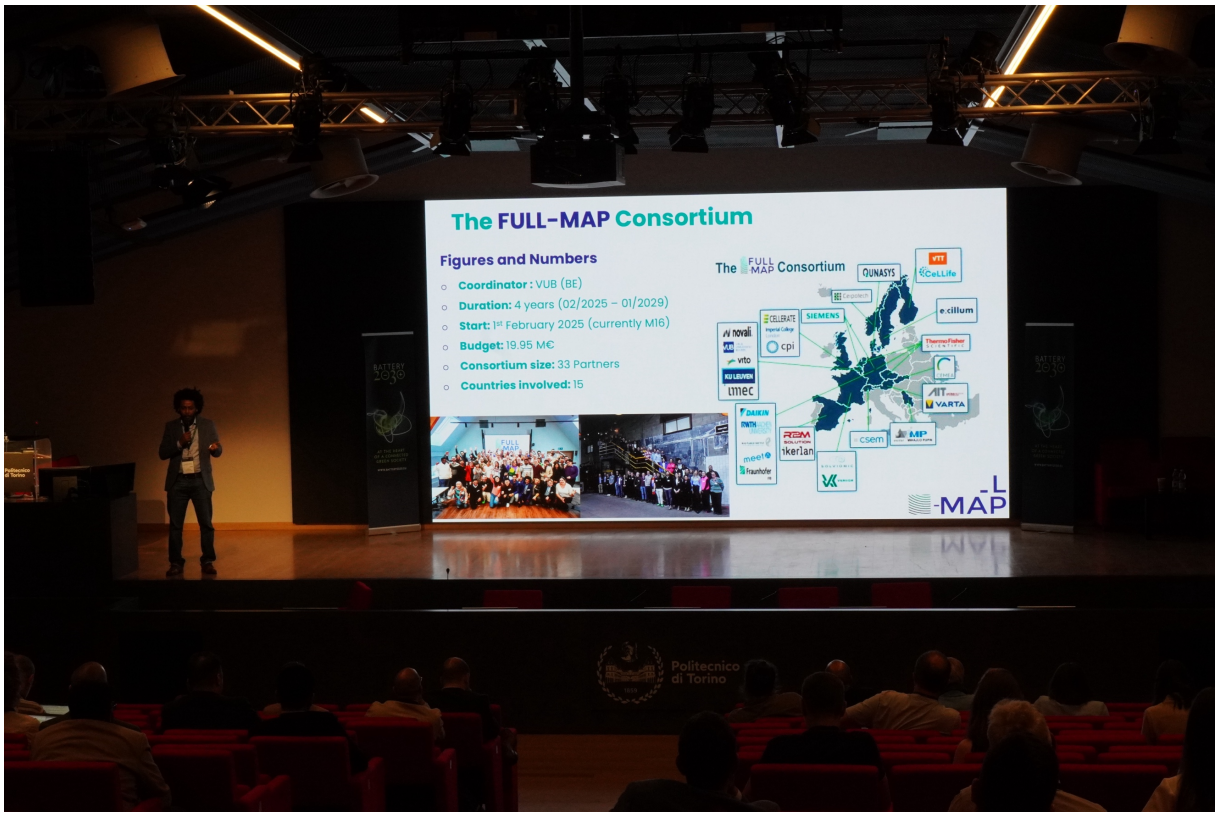

MANUFACTURING PROCESS CHAINS
FOR LI-ION BATTERIES: SCRAP AND RAMP-UP
BATTERY 2030
Several distributed root causes for defect affect the achievement of target effective production rates (throughput of conforming parts), especially in the ramp-up phase.
Electrode production
Cell assembly & finishing
Anode Materials
Anode
Cathode
Cathode Materials
Copper
Aluminum
Separator
Pouch Foil
Electrolyte
Dry room
Electric Energy
Slurry concentration
Coating width, film thickness
Thickness variability
Cutting width, burrs
Geometry, alignment
Strength
Leakage
Functional KPIs
Cumulative throughput loss during to the ramp-up phase
Target
Real
Time
Ramp-up time
Colledani, M., et al. (2018). Production quality improvement during manufacturing systems ramp-up. CIRP JMST.
Fraunhofer FFB, RWTH, "Mastering Ramp-up of Battery Production», 2024.
4


BATTERY 2030
BATTwin
Flexible and scalable digital-twin platform for enhanced production efficiency and yield in battery cell production line
Thank you!
mariachiara.Magnanini@polimi.it
Politecnico di Milano, Department of Mechanical Engineering
POLITECNICO MILANO 1863
HESAM UNIVERSITÉ
le cnam
CESI
VERKOR
COMAU
KTH
upcell
HUN REN
SZTAKI
SUNLIGHT
SYXIS
N-ABLE
Schneider
Ansys
23

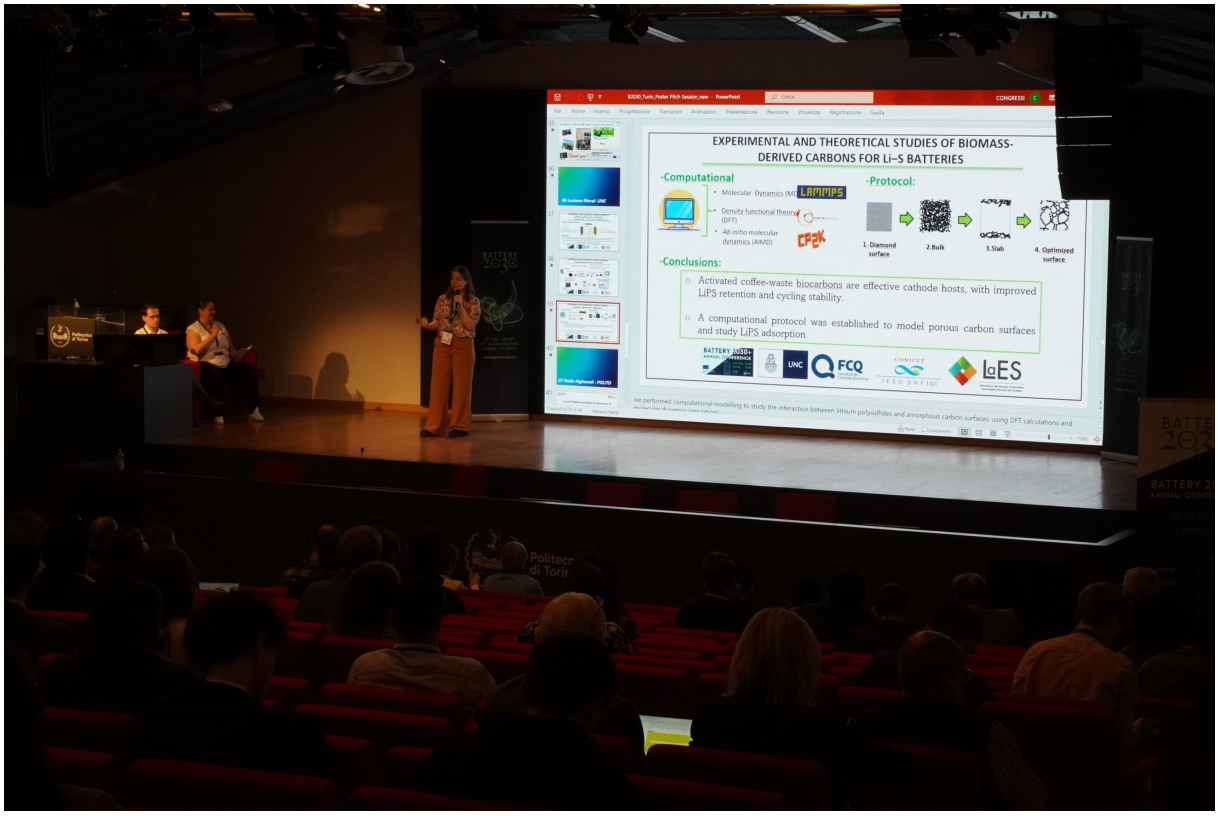

Conventional paradigm: Squential trial-and-error Materials Discovery and Battery development
1. Advanced Materials Discovery
Atomic-scale modelling and prediction
2. Precision Chemical Synthesis
High-purity material fabrication and control
3. Comprehensive Characterization
Advanced metrology and multi-modal analysis
4. Multi-Cell Prototyping & Testing
Performance and failure mechanism modeling
5. Module & System Integration
Scale-up and field-level validation
Optimized Materials Discovery
Materials validation needed
Targeted crystal structure
Phase impurity
Verified interfacial stability
Defect analysis required
High Coulombic efficiency
Unexpected degradation
System-wide verification
Operational optimization
Long-term performance degradation
Critical failure risk assessment
RECYCLE / END OF LIFE
Images Gemini
ULL
-MAP


FULL-MAP : AI-accelerated Close-loop Materials Discovery
1. Advanced Materials Discovery
AI-POWERED PREDICTION ENGINE
2. Precision Chemical Synthesis
3. Comprehensive Characterization
4. Multi-Cell Prototyping & Testing
5. Module & System Integration
Optimized Materials Discovery
Materials validation needed
Targeted Library of structures
Continuous material formulation
Advanced metrology computing nodes
Data seamlessly integrated for AI feedback
High Coulombic efficiency
Continuous multi-format prototyping
System-wide verification
Operational optimization
CLOSED-LOOP FEEDBACK
Real-time characterization and testing data re-trains AI models
END-LIFE
CONTINUOUS INNOVATION & RECYCLE/END OF LIFE LOOP
ROBOTICALLY ACCELERATED HIGH-THROUGHPUT FACILITY
Chemistry Neutral and Versatile, Autonomous MAP
CHEMISTRY NEUTRAL
VERSATILE
AUTONOMOUS
Disruptive battery technologies
Ultra-high performance
Sustainable
Cost effective
Develop a fully autonomous and chemistry-neutral Materials Acceleration Platform (MAP) for battery materials and interfaces able to accelerate the development of new battery chemistries with ultra-high performances by at least a factor of four to five.
FULL
-MAP


The FULL-MAP Consortium
Figures and Numbers
Coordinator : VUB (BE)
Duration: 4 years (02/2025 – 01/2029)
Start: 1st February 2025 (currently M16)
Budget: 19.95 M€
Consortium size: 33 Partners
Countries involved: 15
The FULL MAP Consortium
QUNASYS
CeLLife
SIEMENS
e.cillum
novali
cpi
vito
KU LEUVEN
imec
ThermoFisher
AIT
VARTA
DAIKIN
RWTH
RGM
ikerlan
csem
MP
meet
Fraunhofer
Politecnico di Torino


MAESTRO: AI Orchestration In The Lab
Chat Interface
Experimental Visualisation
Live Monitoring
LLM
Synthesizer
Tester
Optimizer
Validator
Web Search
Status
Experimental Log


EXPERIMENTAL AND THEORETICAL STUDIES OF BIOMASS-DERIVED CARBONS FOR Li–S BATTERIES
-Computational
-Protocol:
LAMMPS
CP2K
1. Diamond surface
2.Bulk
3.Slab
4. Optimized surface
-Conclusions:
Activated coffee-waste biocarbons are effective cathode hosts, with improved LiPS retention and cycling stability.
A computational protocol was established to model porous carbon surfaces and study LiPS adsorption.
UNC
FCQ
LaES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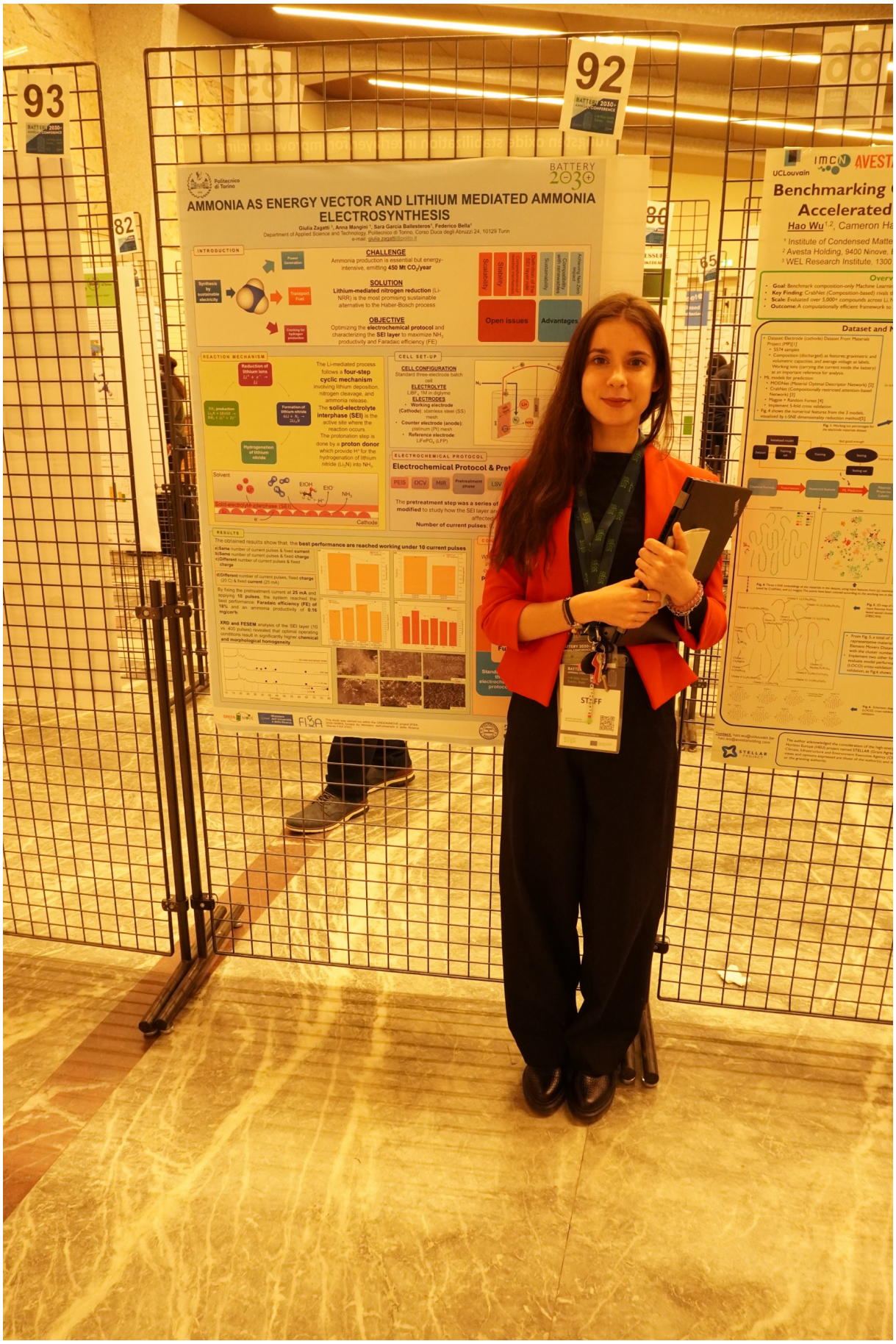

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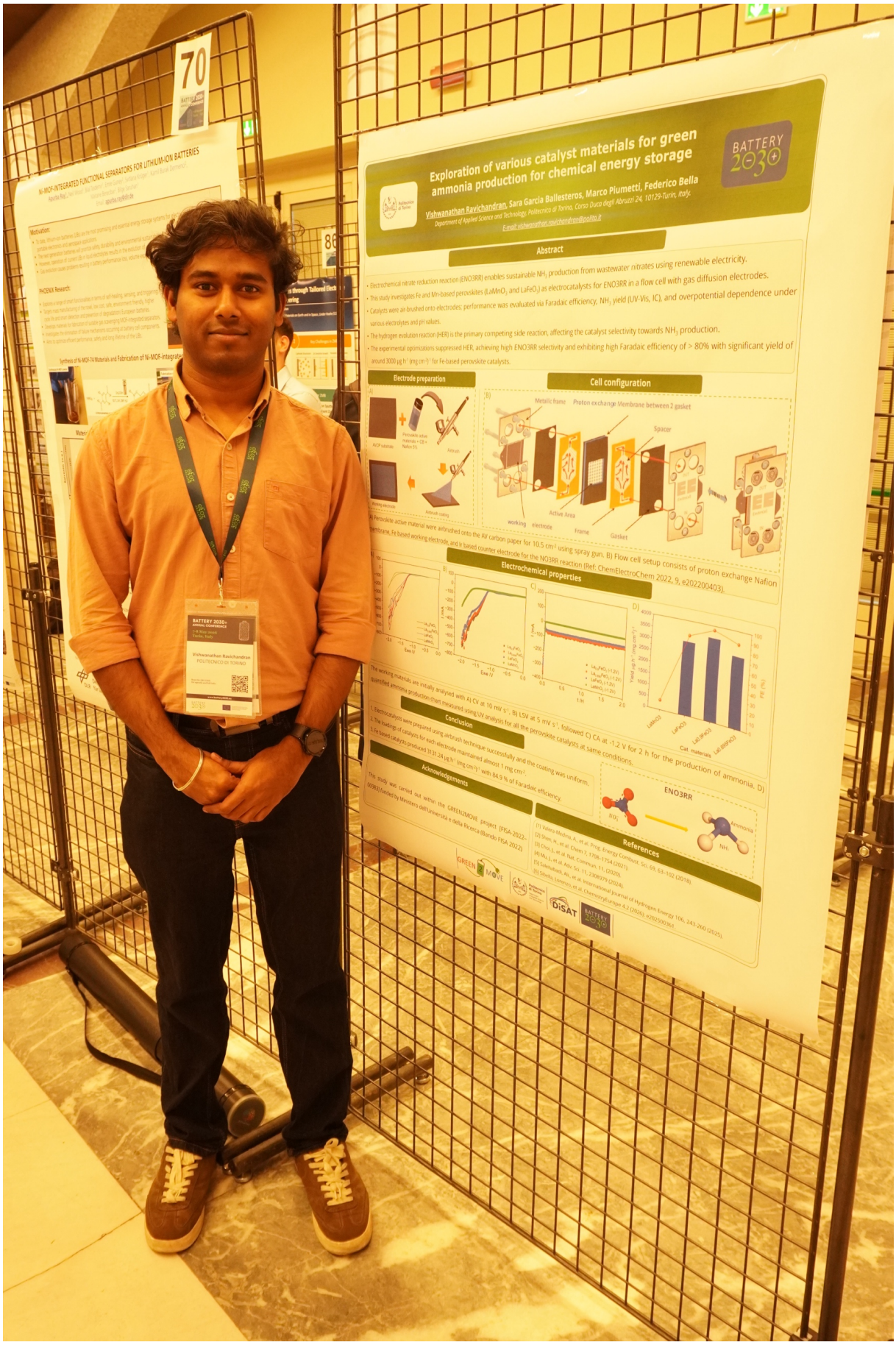
BATTERY 2030+
Politecnico di Torino
AMMONIA AS ENERGY VECTOR AND LITHIUM MEDIATED AMMONIA ELECTROSYNTHESIS
Giulia Zagatti, Anna Mangini, Sara Garcia Ballesteros, Federico Bella
INTRODUCTION
CHALLENGE
SOLUTION
OBJECTIVE
Open issues
Advantages
REACTION MECHANISM
CELL SET-UP
ELECTROCHEMICAL PROTOCOL
RESULTS
UCLouvain
Benchmarking
Accelerated
Hao Wu
Dataset and
STAFF


70
Ni-MOF-INTEGRATED FUNCTIONAL SEPARATORS FOR LITHIUM-ION BATTERIES
Exploration of various catalyst materials for green ammonia production for chemical energy storage
BATTERY 2030+
Vishwanathan Ravichandran, Sara Garcia Ballesteros, Marco Piumetti, Federico Bella
Politecnico di Torino
Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129-Turin, Italy.
E-mail: vishwanathan.ravichandran@polito.it
Abstract
Electrode preparation
Cell configuration
Electrochemical properties
Conclusion
Acknowledgements
References
ENO3RR
BATTERY 2030+ ANNUAL CONFERENCE
Vishwanathan Ravichandran
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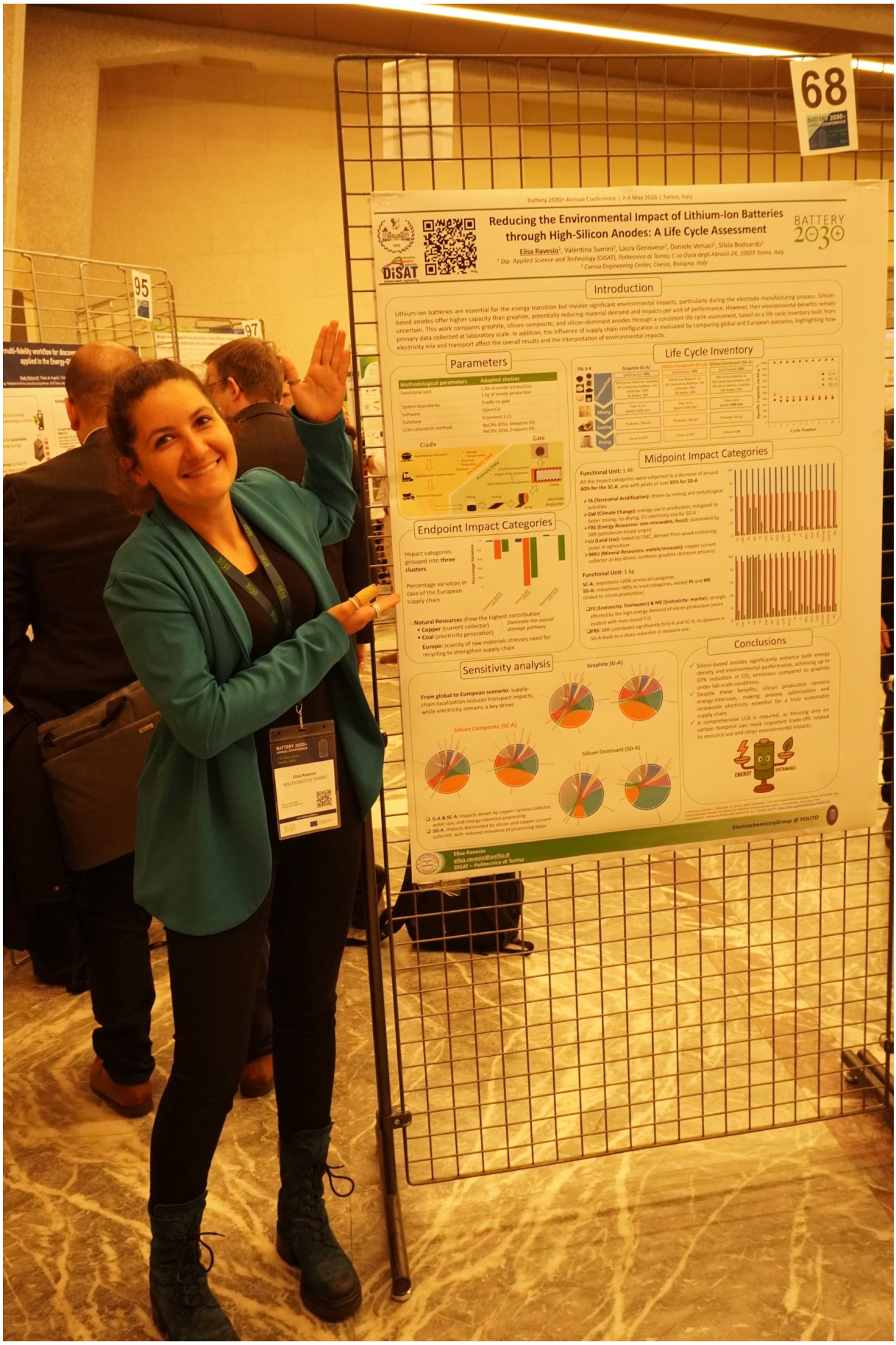
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Battery 2030+ Annual Conference | 7-8 May 2026 | Torino, Italy
Reducing the Environmental Impact of Lithium-Ion Batteries through High-Silicon Anodes: A Life Cycle Assessment
Elisa Ravesio[1], Valentina Suminì[2], Laura Genovese[2], Daniele Versaci[2], Silvia Bodoardo[1]
[1] Dip. Applied Science and Technology (DISAT), Politecnico di Torino, C.so Duca degli Abruzzi 24, 10029 Torino, Italy
[2] Coesia Engineering Center, Coesia, Bologna, Italy
DiSAT
BATTERY 2030+
Introduction
Lithium-ion batteries are essential for the energy transition but involve significant environmental impacts, particularly during the electrode manufacturing process. Silicon-based anodes offer higher capacity than graphite, potentially reducing material demand and impacts per unit of performance. However, their environmental benefits remain uncertain. This work compares graphite, silicon-composite, and silicon-dominant anodes through a consistent life cycle assessment, based on a life cycle inventory built from primary data collected at laboratory scale. In addition, the influence of supply chain configuration is evaluated by comparing global and European scenarios, highlighting how electricity mix and transport affect the overall results and the interpretation of environmental impacts.
Parameters
Methodological parameters
Adopted choices
Functional unit
1 Ah of anode production
1 kg of anode production
System boundaries
Cradle-to-gate
Software
OpenLCA
Database
Ecoinvent 3.11
LCIA calculation method
ReCiPe 2016, Midpoint (H)
ReCiPe 2016, Endpoint (H)
Cradle
Gate
Life Cycle Inventory
TRL 3-4
Graphite (G-A)
Silicon Composite (SC-A)
Silicon Dominant (SD-A)
Mixing
Coating
Drying
Cycle Number
Midpoint Impact Categories
Functional Unit: 1 Ah
All the impact categories were subjected to a decrease of around 60% for the SC-A, and with peaks of over 95% for SD-A
TA (Terrestrial Acidification): driven by mining and metallurgical activities
GW (Climate Change): energy use in production; mitigated by faster mixing, no drying, EU electricity mix for SD-A
FRS (Energy Resources: non-renewable, fossil): dominated by SBR (petroleum-based origin)
LU (Land Use): linked to CMC, derived from wood-containing pulps in agriculture
MRU (Mineral Resources: metals/minerals): copper current collector as key driver; synthetic graphite (Acheson process)
Functional Unit: 1 kg
SC-A: reductions <20% across all categories
SD-A: reductions >90% in most categories, except FE and ME (linked to silicon production)
FE (Ecotoxicity: freshwater) & ME (Ecotoxicity: marine): strongly affected by the high energy demand of silicon production (more evident with mass-based FU)
FRS: SBR contributes significantly to G-A and SC-A; its absence in SD-A leads to a sharp reduction in resource use
Endpoint Impact Categories
Impact categories grouped into three clusters
Percentage variation in case of the European supply chain
Percentage Variation
Natural Resources show the highest contribution
Copper (current collector)
Coal (electricity generation)
Dominate the overall damage pathway
Europe: scarcity of raw materials stresses need for recycling to strengthen supply chain
Sensitivity analysis
From global to European scenario: supply-chain localization reduces transport impacts, while electricity remains a key driver
Graphite (G-A)
Silicon Composite (SC-A)
Silicon Dominant (SD-A)
G-A & SC-A: impacts driven by copper current collector, water use, and energy-intensive processing
SD-A: impacts dominated by silicon and copper current collector, with reduced relevance of processing steps
Conclusions
Silicon-based anodes significantly enhance both energy density and environmental performance, achieving up to 97% reduction in CO2 emissions compared to graphite under lab-scale conditions.
Despite these benefits, silicon production remains energy-intensive, making process optimization and renewable electricity essential for a truly sustainable supply chain.
A comprehensive LCA is required, as focusing only on carbon footprint can mask important trade-offs related to resource use and other environmental impacts.
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Elisa Ravesio
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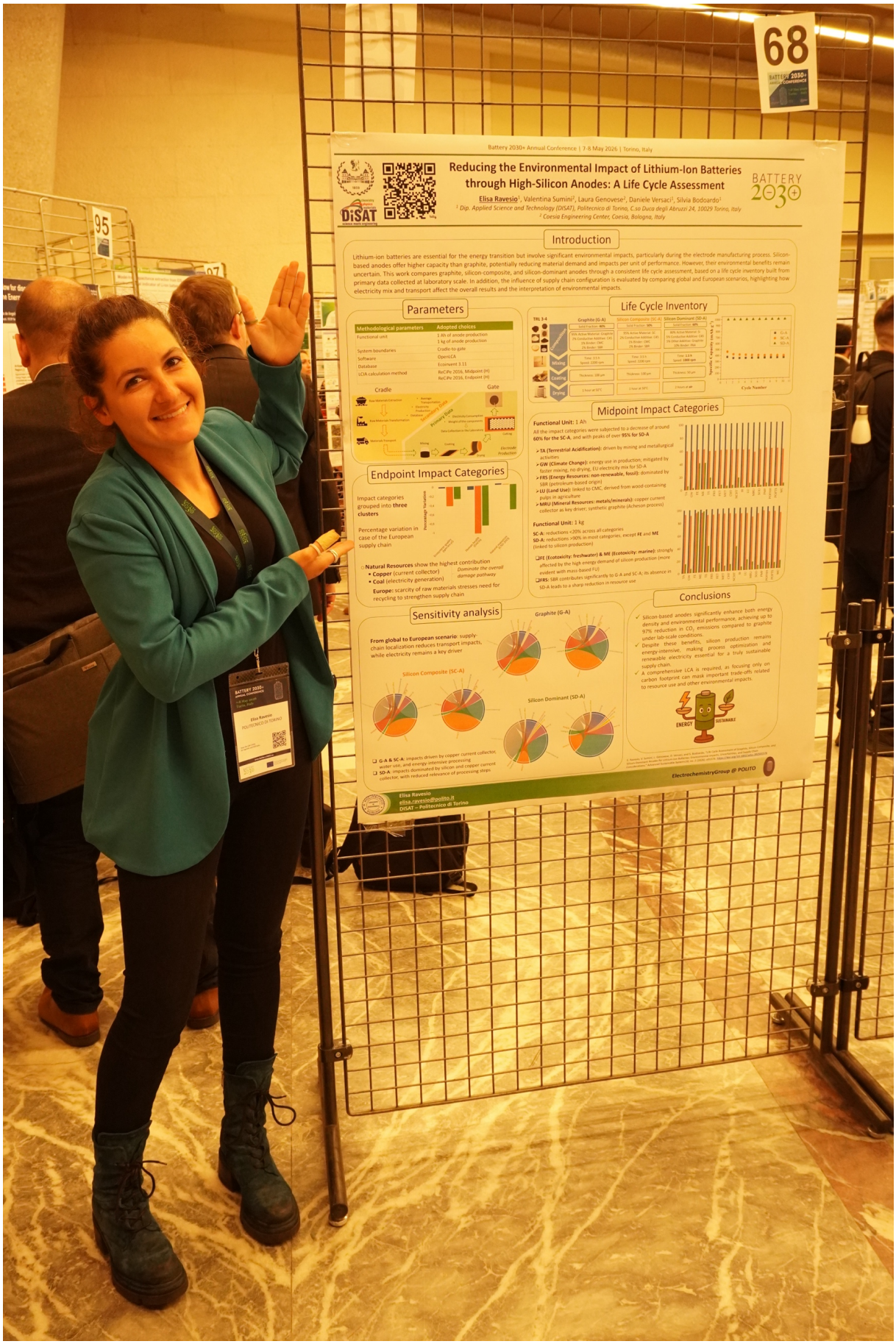
BATTERY 2030+
Elisa Ravesio
POLITECNICO DI TORINO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BATTERY 2030+
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LCIA calculation method
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Primary Data
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Natural Resources show the highest contribution
Copper (current collector)
Coal (electricity generation)
Dominate the overall damage pathway
Europe: scarcity of raw materials stresses need for recycling to strengthen supply chain
Life Cycle Inventory
TRL 3-4
Graphite (G-A)
Silicon Composite (SC-A)
Silicon Dominant (SD-A)
Solid Fraction: 40%
Solid Fraction: 50%
Solid Fraction: 60%
Mixing
Coating
Drying
Thickness: 100 µm
Thickness: 130 µm
Thickness: 90 µm
1 hour at 50°C
1 hour at 50°C
2 hours at 40°
Specific Capacity (mAh g⁻¹)
Cycle Number
Midpoint Impact Categories
Functional Unit: 1 Ah
All the impact categories were subjected to a decrease of around 60% for the SC-A, and with peaks of over 95% for SD-A
TA (Terrestrial Acidification): driven by mining and metallurgical activities
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ENERGY
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ElectrochemistryGroup @ POLITO
Elisa Ravesio
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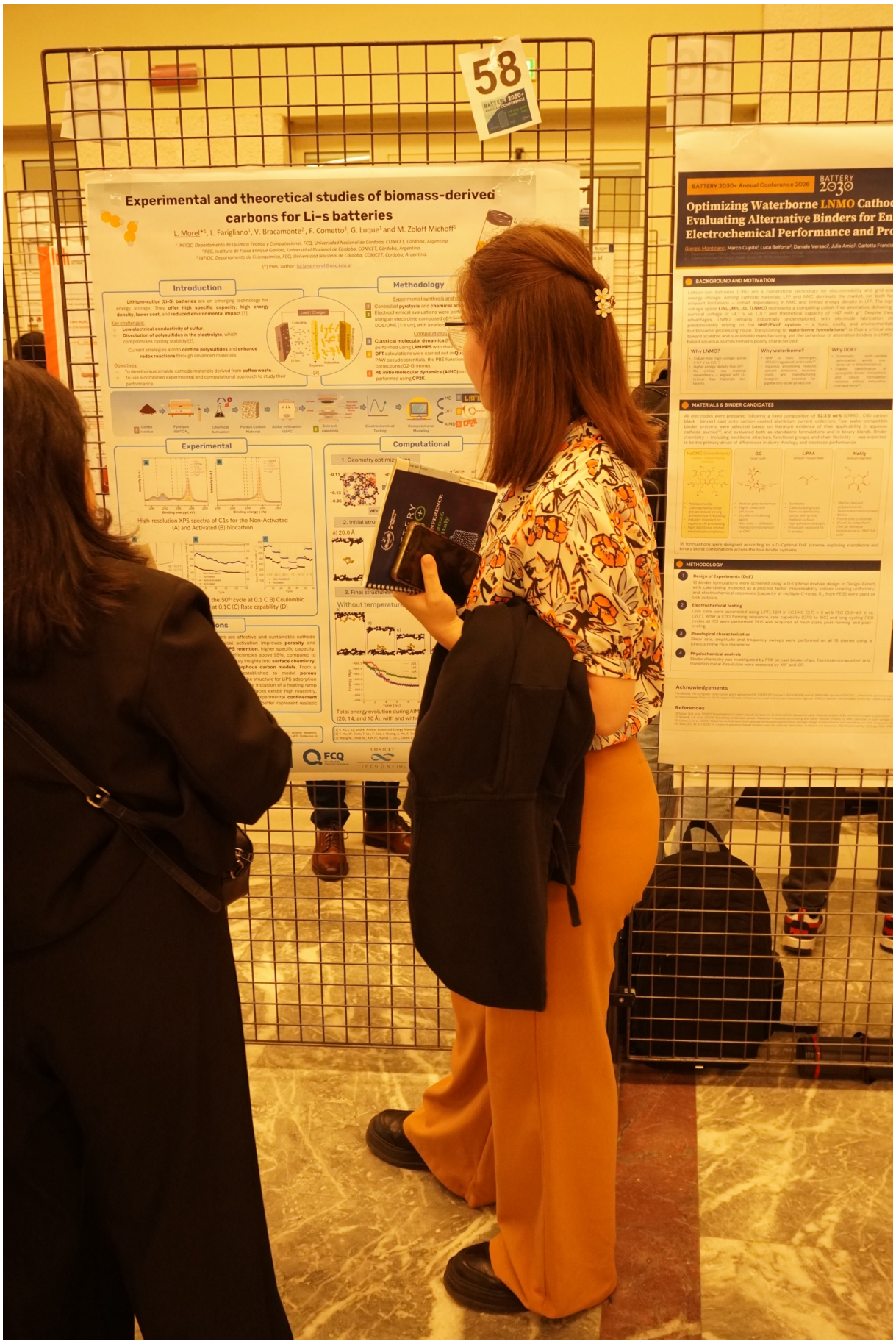
58
Experimental and theoretical studies of biomass-derived carbons for Li–s batteries
Introduction
Methodology
Experimental
Computational
BATTERY 2030+ Annual Conference 2026
Optimizing Waterborne LNMO Cathod
Evaluating Alternative Binders for En
Electrochemical Performance and Pro
BACKGROUND AND MOTIVATION
MATERIALS & BINDER CANDIDATES
METHODOLOGY
Acknowledgements
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58
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Introduction
Methodology
Experimental
BATTERY 2030+ Annual Conference 2026
Optimizing Waterborne LNM
Evaluating Alternative Binde
Electrochemical Performanc
BACKGROUND AND MOTIVATION
MATERIALS & BINDER CANDIDATES


61
60
BATTERY 2030+
STAFF
SYNTHESIS AND CHARACTERIZATION OF MnO_2 AS CATHODES FOR KIBs
Francesco Nencini, Daniele Versaci, Federico Bella
Electrochemistry Group, Department of Applied Science and Technology (DISAT), Politecnico di Torino, c.so Duca degli Abruzzi 24, 10129 Torino, Italy
INTRODUCTION
Birnessite
Vs
Cryptomelane
MATERIAL SYNTHESIS
HCl (dropwise)
100 °C for 10 min (Oxidation)
Birnessite
400 °C for 60 h (Calcination)
Cryptomelane
COIN CELL PREPARATION
MATERIAL CHARACTERIZATION
ELECTROCHEMICAL CHARACTERIZATION
Cyclic voltammetry
Galvanostatic cycling
FUTURE WORKS
ACKNOWLEDGEMENT


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60
SYNTHESIS AND CHARACTERIZATION OF MnO_2 AS CATHODES FOR KIBs
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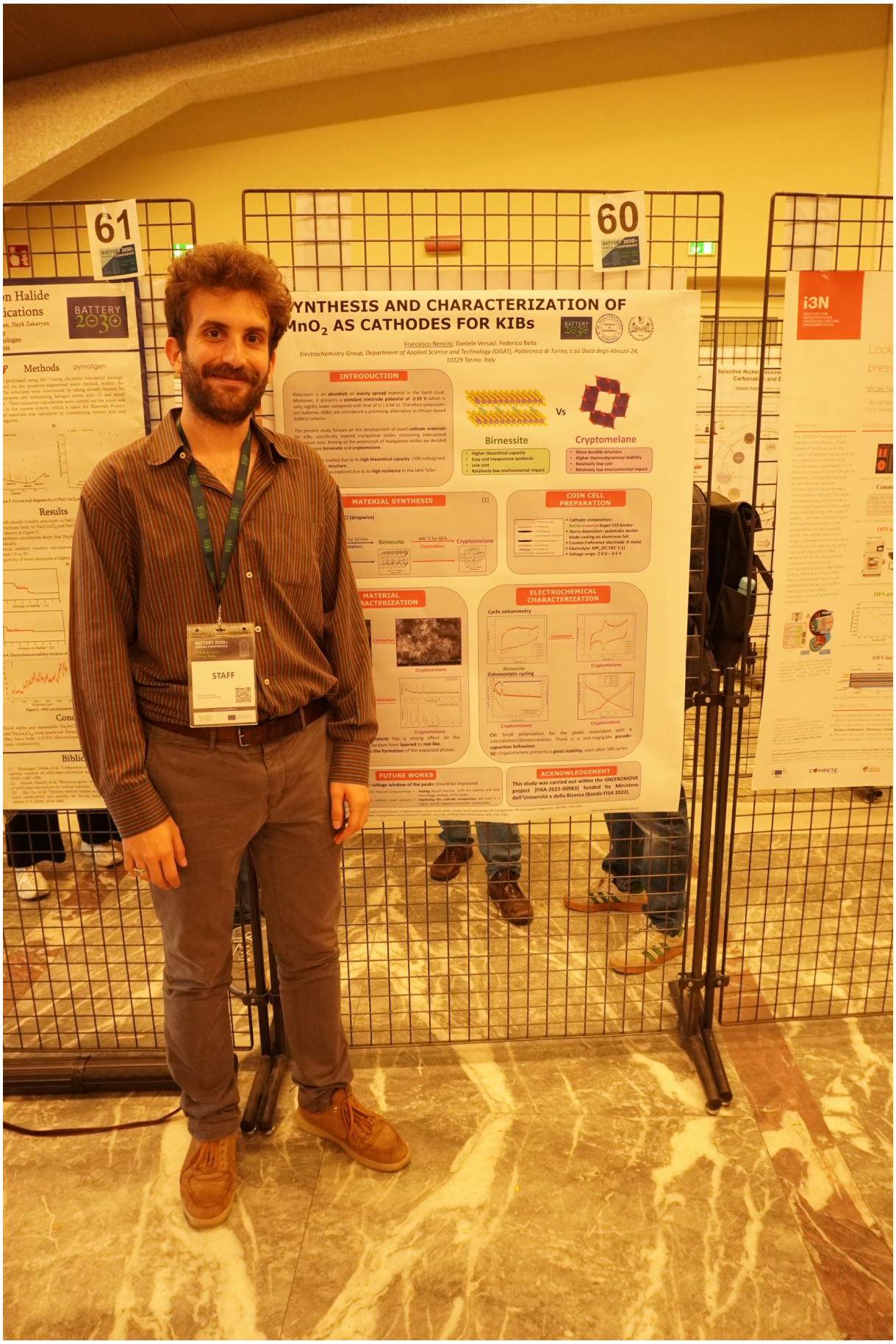
Electrochemistry Group, Department of Applied Science and Technology (DISAT), Politecnico di Torino, c.so Duca degli Abruzzi 24, 10129 Torino, Italy
INTRODUCTION
Potassium is an abundant an evenly spread material in the Earth crust. Moreover, it presents a standard electrode potential of -2.93 V which is only slightly lower compared with that of Li (-3.04 V). Therefore potassium-ion batteries (KIBs) are considered a promising alternative to lithium-based battery systems.
The present study focuses on the development of novel cathode materials for KIBs, specifically layered manganese oxides containing intercalated potassium ions. Among all the polymorph of manganese oxides we decided to investigate birnessite and cryptomelane.
Birnessite was studied due to its high theoretical capacity (308 mAh/g) and wide interlayer structure;
Cryptomelane was explored due to its high resilience to the Jahn-Teller effect.
Vs
Birnessite
Higher theoretical capacity
Easy and inexpensive synthesis
Low cost
Relatively low environmental impact
Cryptomelane
More durable structure
Higher thermodynamical stability
Relatively low cost
Relatively low environmental impact
MATERIAL SYNTHESIS
[1]
$KMnO_4$
HCl (dropwise)
100 °C for 10 min
(Oxidation)
Birnessite
400 °C for 60 h
(Calcination)
Cryptomelane
COIN CELL PREPARATION
Cathode composition:
Active material:Super C65:binder
Slurry deposition: automatic doctor blade casting on aluminum foil
Counter/reference electrode: K metal
Electrolyte: KPF_6 (EC:DEC 1:1)
voltage range: 2.0 V – 3.5 V
MATERIAL CHARACTERIZATION
Calcination
Cryptomelane
Birnessite
Calcination
Cryptomelane
thermal treatment has a strong effect on the
The structure evolves from layered to rod-like
analysis confirms the formation of the expected phases.
ELECTROCHEMICAL CHARACTERIZATION
Cyclic voltammetry
Calcination
Cryptomelane
Birnessite
Galvanostatic cycling
Cryptomelane
Cryptomelane
CV: Small polarization for the peaks associated with K intercalation/deintercalation. There is a non-negligible pseudo-capacitive behaviour.
GC: Cryptomelane presents a good stability, even after 100 cycles.
FUTURE WORKS
and the voltage window of the peaks should be improved:
Doping should improve both the stability and rate
the voltage window of the peaks.
Improving the cathode composition will lead to a higher specific capacity and better conductivity.
ACKNOWLEDGEMENT
This study was carried out within the GREEN2MOVE project [FISA-2022-00983] funded by Ministero dell'Università e della Ricerca (Bando FISA 2022).
STAFF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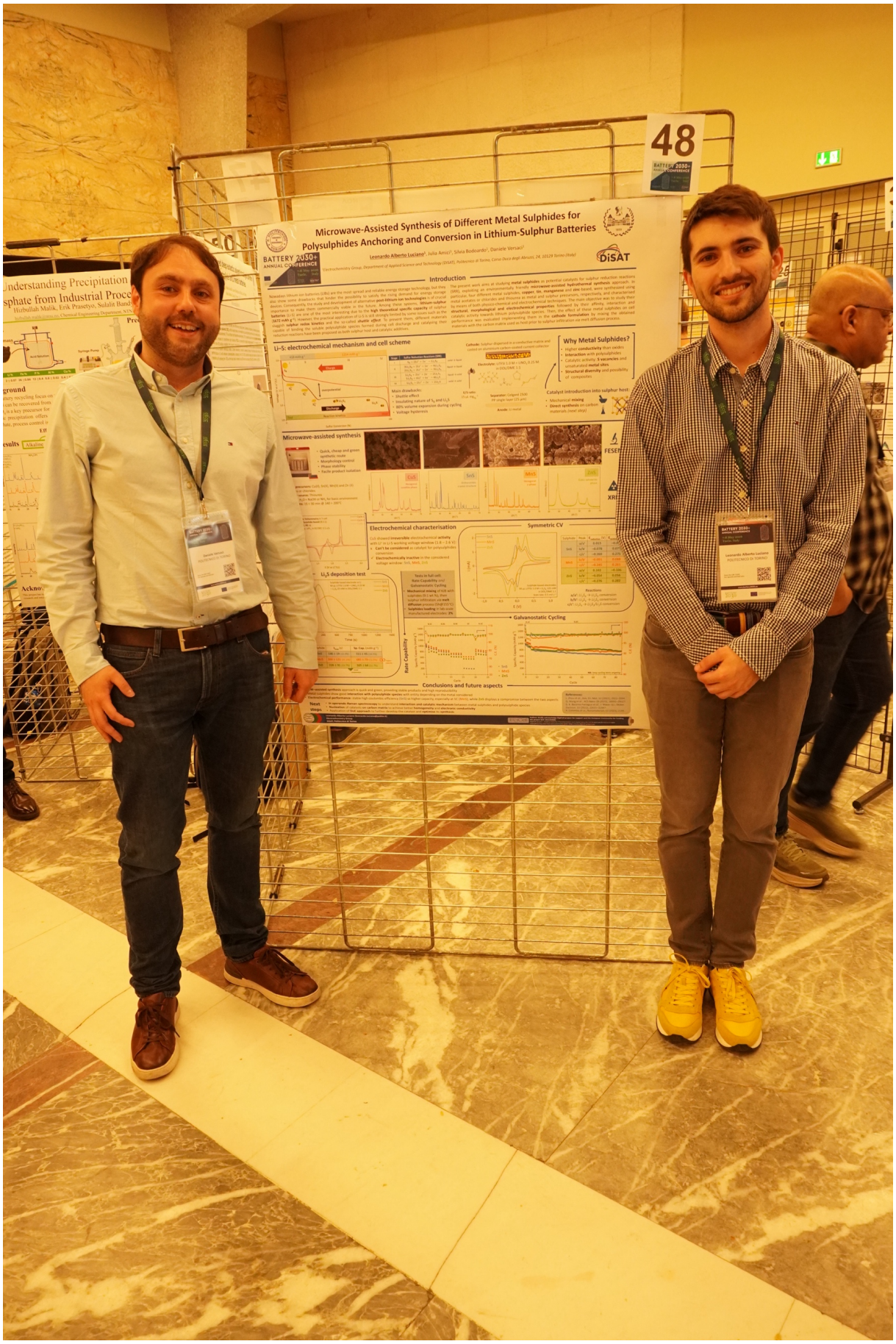
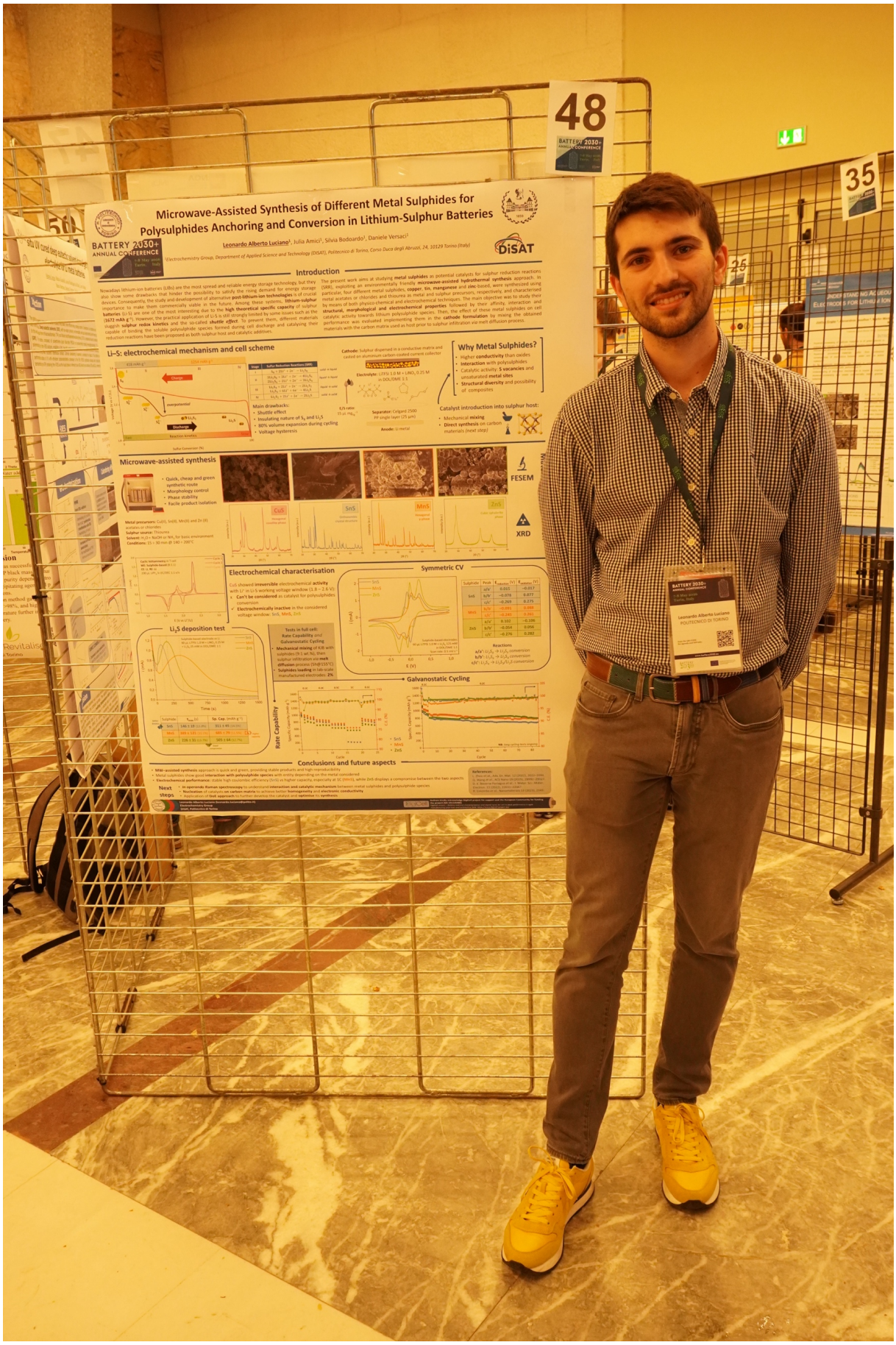
BATTERY 2030+
STAFF
SYNTHESIS AND CHARACTERIZATION OF MnO_2 AS CATHODES FOR KIBs
Francesco Nencini, Daniele Versaci, Federico Bella
Electrochemistry Group, Department of Applied Science and Technology (DISAT), Politecnico di Torino, c.so Duca degli Abruzzi 24, 10129 Torino, Italy
INTRODUCTION
Birnessite
Vs
Cryptomelane
MATERIAL SYNTHESIS
COIN CELL PREPARATION
ELECTROCHEMICAL CHARACTERIZATION
FUTURE WORKS
ACKNOWLEDGEMENT
i3N
Methods
Results


48
Microwave-Assisted Synthesis of Different Metal Sulphides for Polysulphides Anchoring and Conversion in Lithium-Sulphur Batteries
Leonardo Alberto Luciano, Julia Amici, Silvia Bodoardo, Daniele Versaci
DiSAT
Introduction
Why Metal Sulphides?
Li–S: electrochemical mechanism and cell scheme
Microwave-assisted synthesis
Electrochemical characterisation
Symmetric CV
Galvanostatic Cycling
Conclusions and future aspects
Leonardo Alberto Luciano
POLITECNICO DI TORINO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DISAT
Introduction
Li–S: electrochemical mechanism and cell scheme
Why Metal Sulphides?
Microwave-assisted synthesis
FESEM
XRD
Electrochemical characterisation
Symmetric CV
Li2S deposition test
Galvanostatic Cycling
Conclusions and future aspects
Leonardo Alberto Luciano
POLITECNICO DI TORINO


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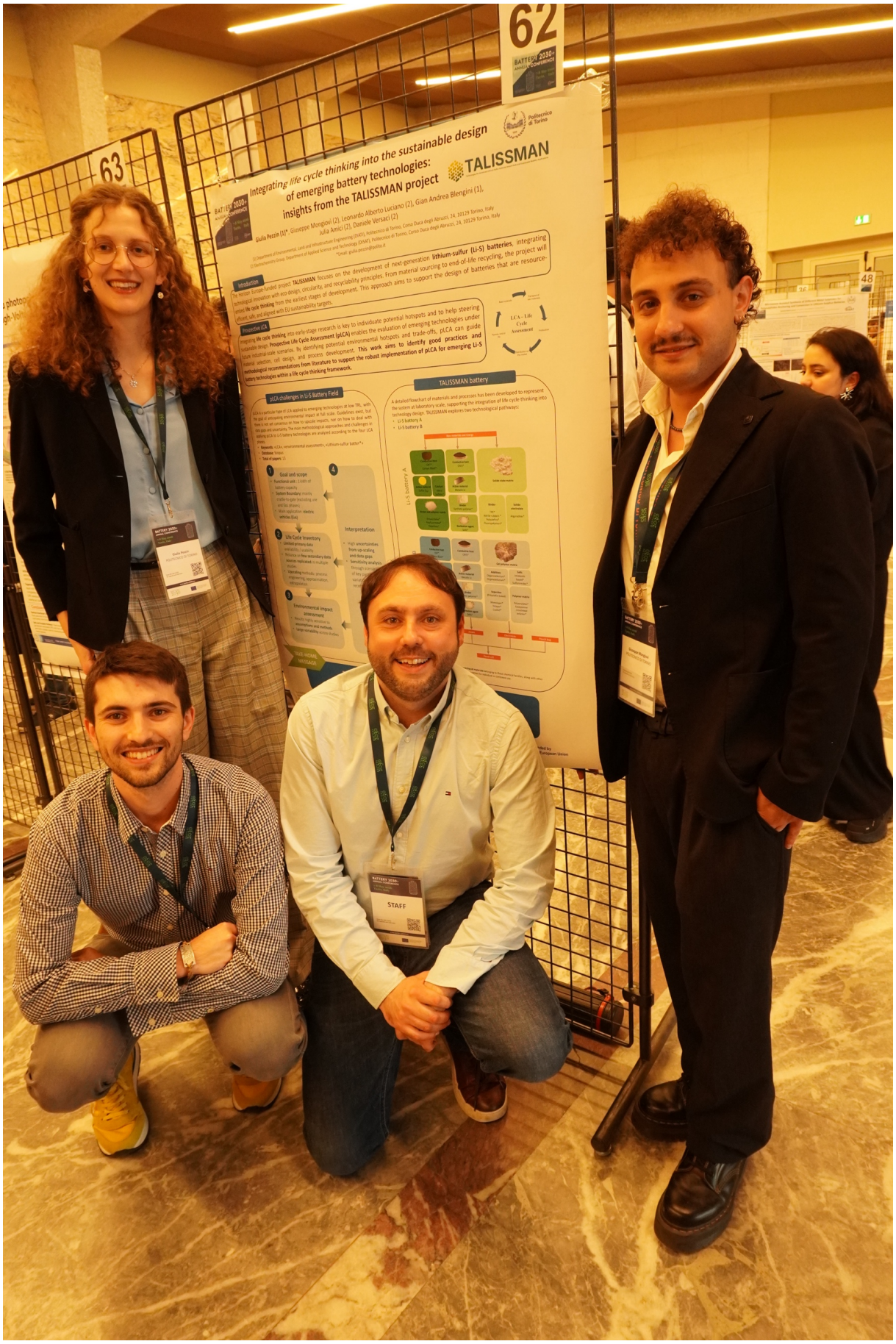
Politecnico di Torino
MODELING THE LIMITED MASS TRASPORT OF POLYSULFIDES TO UNDERSTAND CAPACITY LOSS DURING CHARGE AND DISCHARGE
Tommaso Filippo Lupatelli, Daniele Versaci, Massimo Santarelli, Silvia Bodoardo
STEPS
INTRODUCTION
Lithium Anode
Cathode
Dissolved polysulfides
Lithium polysulfides
Solid Sulfur
Lithium ion
Separator
MODEL DEVELOPMENT
Build a solid computational framework for long cycling modeling
Optimal rule of Li-ion diffusivity for both reversible and irreversible losses
Experimental coherent description of shuttling
REVERSIBLE LOSSES
GOVERNING EQUATIONS
BOUNDARY CONDITIONS
SHUTTLING IMPLEMENTATION
MASS TRANSPORT
REACTION RATE
DECELERATION
IRREVERSIBLE LOSSES
CONCLUSION
ACKNOWLEDGMENTS
BATTERY 2030+
Tommaso Filippo Lupatelli
POLITECNICO DI TORINO
Conclusion
Revitalise
Politecnico di Torino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Integrating life cycle thinking into the sustainable design of emerging battery technologies: insights from the TALISSMAN project
TALISSMAN
Introduction
Prospective LCA
LCA - Life Cycle Assessment
pLCA challenges in Li-S Battery Field
TALISSMAN battery
Goal and scope
Life Cycle Inventory
Environmental impact assessment
Interpretation
TAKE-HOME MESSAGE
STAFF


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Integrating life cycle thinking into the sustainable design of emerging battery technologies: insights from the TALISSMAN project
TALISSMAN
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Prospective LCA
pLCA challenges in Li-S Battery Field
TALISSMAN battery
Goal and scope
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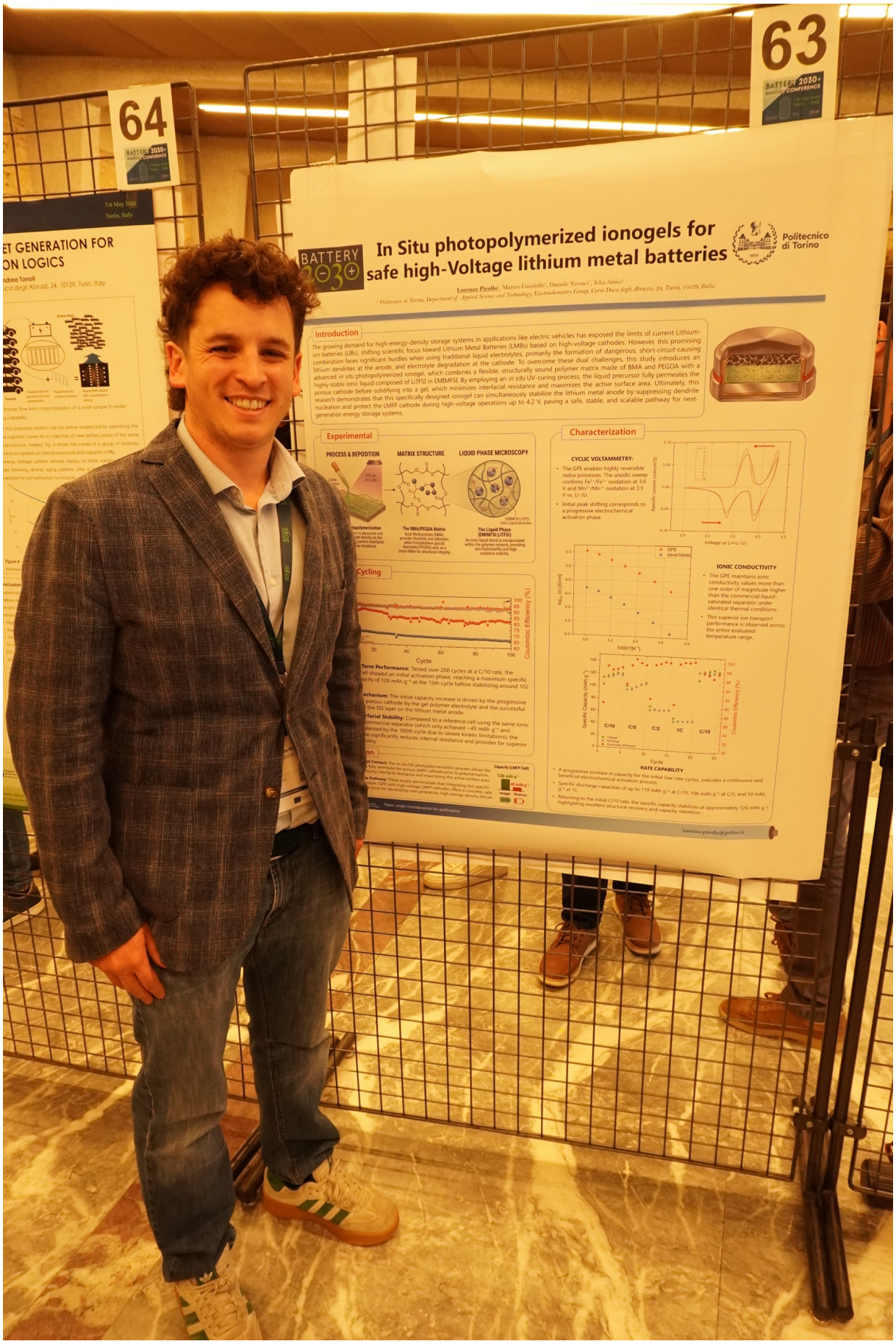
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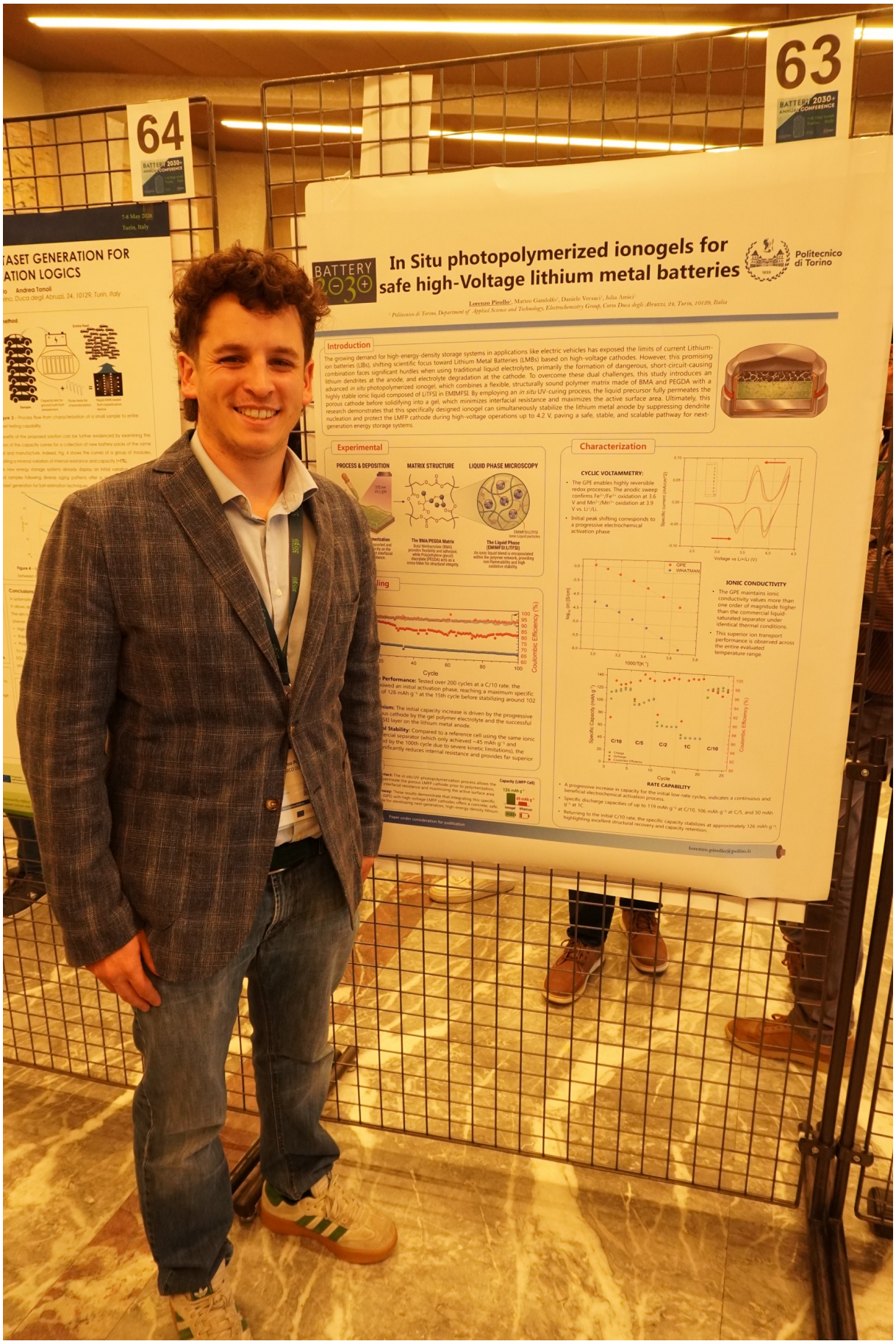
64
BATTERY 2030+
In Situ photopolymerized ionogels for safe high-Voltage lithium metal batteries
Politecnico di Torino
Lorenzo Pirollo, Matteo Gandolfo, Daniele Versaci, Julia Amici
Introduction
The growing demand for high-energy-density storage systems in applications like electric vehicles has exposed the limits of current Lithium-ion batteries (LIBs), shifting scientific focus toward Lithium Metal Batteries (LMBs) based on high-voltage cathodes. However, this promising combination faces significant hurdles when using traditional liquid electrolytes, primarily the formation of dangerous, short-circuit-causing lithium dendrites at the anode, and electrolyte degradation at the cathode. To overcome these dual challenges, this study introduces an advanced in situ photopolymerized ionogel, which combines a flexible, structurally sound polymer matrix made of BMA and PEGDA with a highly stable ionic liquid composed of LiTFSI in EMIMFSI. By employing an in situ UV-curing process, the liquid precursor fully permeates the porous cathode before solidifying into a gel, which minimizes interfacial resistance and maximizes the active surface area. Ultimately, this research demonstrates that this specifically designed ionogel can simultaneously stabilize the lithium metal anode by suppressing dendrite nucleation and protect the LMFP cathode during high-voltage operations up to 4.2 V, paving a safe, stable, and scalable pathway for next-generation energy storage systems.
Experimental
PROCESS & DEPOSITION
MATRIX STRUCTURE
LIQUID PHASE MICROSCOPY
The BMA/PEGDA Matrix
The Liquid Phase (EMIM+/Si(LiTFSI)
Characterization
CYCLIC VOLTAMMETRY:
The GPE enables highly reversible redox processes. The anodic sweep confirms Fe2+/Fe3+ oxidation at 3.6 V and Mn2+/Mn3+ oxidation at 3.9 V vs. Li+/Li.
Initial peak shifting corresponds to a progressive electrochemical activation phase
Specific current (mA/cm²)
Voltage vs Li+/Li (V)
IONIC CONDUCTIVITY
The GPE maintains ionic conductivity values more than one order of magnitude higher than the commercial liquid-saturated separator under identical thermal conditions.
This superior ion transport performance is observed across the entire evaluated temperature range.
GPE
WHATMAN
1000/T(K⁻¹)
Cycling
Coulombic Efficiency (%)
Cycle
Term Performance: Tested over 200 cycles at a C/10 rate, the cell showed an initial activation phase, reaching a maximum specific capacity of 126 mAh g⁻¹ at the 15th cycle before stabilizing around 102
echanism: The initial capacity increase is driven by the progressive porous cathode by the gel polymer electrolyte and the successful the SEI layer on the lithium metal anode.
facial Stability: Compared to a reference cell using the same ionic commercial separator (which only achieved ~45 mAh g⁻¹ and varized by the 100th cycle due to severe kinetic limitations), the e significantly reduces internal resistance and provides far superior ility.
on
Capacity (LMFP Cell)
126 mAh g⁻¹
45 mAh g⁻¹
Ionogel
Whatman
Specific Capacity (mAh g⁻¹)
C/10
C/5
C/2
1C
C/10
Charge
Discharge
Coulombic Efficiency
RATE CAPABILITY
A progressive increase in capacity for the initial low-rate cycles, indicates a continuous and beneficial electrochemical activation process.
Specific discharge capacities of up to 119 mAh g⁻¹ at C/10, 106 mAh g⁻¹ at C/5, and 50 mAh g⁻¹ at 1C.
Returning to the initial C/10 rate, the specific capacity stabilizes at approximately 126 mAh g⁻¹, highlighting excellent structural recovery and capacity retention.
Paper under consideration for publication
lorenzo.pirollo@polito.it
7-8 May 2026
Turin, Italy
ET GENERATION FOR
ON LOGICS
ndrea Tonoli
ca degli Abruzzi, 24, 10129, Turin, Italy


63
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BATTERY 2030+
In Situ photopolymerized ionogels for safe high-Voltage lithium metal batteries
Politecnico di Torino
Introduction
Experimental
Characterization
CYCLIC VOLTAMMETRY:
IONIC CONDUCTIVITY
RATE CAPABILITY


45
Homogenization of LIBs: a fast model for state-of-charge in-line monitoring
A. Lombardo Pontillo[1], E. Buccafusco[1], A. Marcato[1], D. Marchisio[1], G. Boccardo[1], and I. Battiato[2]
[1]MulMoPRO, DISAT, Politecnico di Torino, Italy
[2]Energy Science & Engineering, Stanford University, (CA), US
Politecnico di Torino
Stanford University
Motivation and Goals
Pore Scale Modeling
Effective Coefficients
Upscaled Equations
Results and Verification
Conclusions
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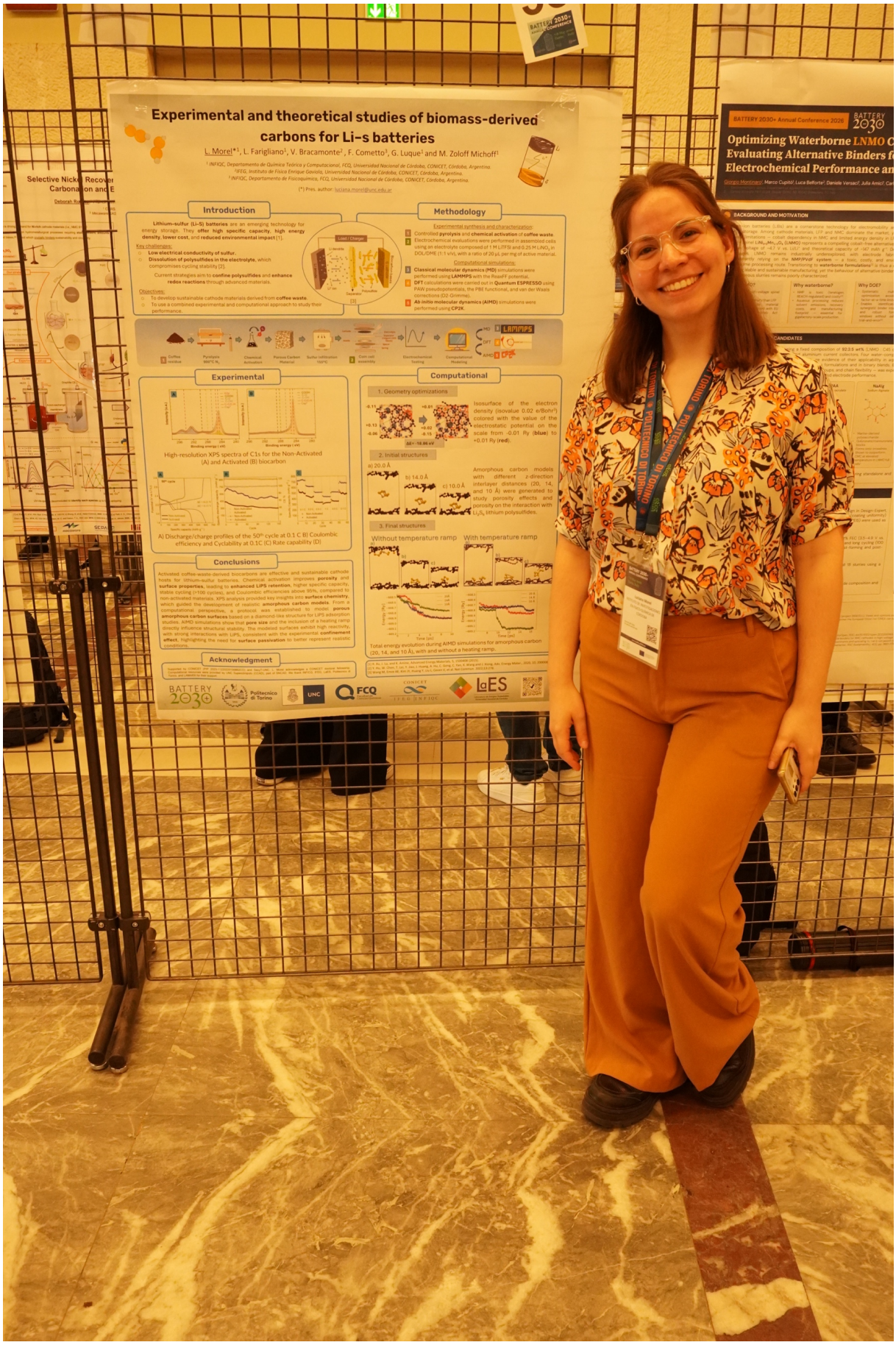
Experimental and theoretical studies of biomass-derived carbons for Li–s batteries
L. Morel*[1], L. Farigliano[1], V. Bracamonte[2], F. Cometto[3], G. Luque[1] and M. Zoloff Michoff[1]
[1] INFIQC, Departamento de Química Teórica y Computacional, FCQ, Universidad Nacional de Córdoba, CONICET, Córdoba, Argentina.
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[3] INFIQC, Departamento de Fisicoquímica, FCQ, Universidad Nacional de Córdoba, CONICET, Córdoba, Argentina.
(*) Pres. author: luciana.morel@unc.edu.ar
Introduction
Lithium–sulfur (Li–S) batteries are an emerging technology for energy storage. They offer high specific capacity, high energy density, lower cost, and reduced environmental impact [1].
Key challenges:
Low electrical conductivity of sulfur.
Dissolution of polysulfides in the electrolyte, which compromises cycling stability [2].
Current strategies aim to confine polysulfides and enhance redox reactions through advanced materials.
Objectives:
To develop sustainable cathode materials derived from coffee waste.
To use a combined experimental and computational approach to study their performance.
Methodology
Experimental synthesis and characterization:
Controlled pyrolysis and chemical activation of coffee waste.
Electrochemical evaluations were performed in assembled cells using an electrolyte composed of 1 M LiTFSI and 0.25 M LiNO3 in DOL/DME (1:1 v/v), with a ratio of 20 µL per mg of active material.
Computational simulations:
Classical molecular dynamics (MD) simulations were performed using LAMMPS with the ReaxFF potential.
DFT calculations were carried out in Quantum ESPRESSO using PAW pseudopotentials, the PBE functional, and van der Waals corrections (D2 Grimme).
Ab initio molecular dynamics (AIMD) simulations were performed using CP2K.
Load / Charge
Discharge
Polysulfide
[3]
Coffee residue
Pyrolysis 900°C N2
Chemical Activation
Porous Carbon Material
Sulfur infiltration 150°C
Coin cell assembly
Electrochemical Testing
Computational Modeling
MD
DFT
AIMD
LAMMPS
CP2K
Experimental
High-resolution XPS spectra of C1s for the Non-Activated (A) and Activated (B) biocarbon
Binding energy (eV)
A) Discharge/charge profiles of the 50th cycle at 0.1 C B) Coulombic efficiency and Cyclability at 0.1C (C) Rate capability (D)
Computational
1. Geometry optimizations
Isosurface of the electron density (isovalue 0.02 e/Bohr³) colored with the value of the electrostatic potential on the scale from -0.01 Ry (blue) to +0.01 Ry (red).
ΔE= -10.86 eV
2. Initial structures
a) 20.0 Å
b) 14.0 Å
c) 10.0 Å
Amorphous carbon models with different z-direction interlayer distances (20, 14, and 10 Å) were generated to study porosity effects and porosity on the interaction with Li2S6 lithium polysulfides.
3. Final structures
Without temperature ramp
With temperature ramp
Time (ps)
Total energy evolution during AIMD simulations for amorphous carbon (20, 14, and 10 Å), with and without a heating ramp.
Conclusions
Activated coffee-waste-derived biocarbons are effective and sustainable cathode hosts for lithium–sulfur batteries. Chemical activation improves porosity and surface properties, leading to enhanced LiPS retention, higher specific capacity, stable cycling (>100 cycles), and Coulombic efficiencies above 95%, compared to non-activated materials. XPS analysis provided key insights into surface chemistry, which guided the development of realistic amorphous carbon models. From a computational perspective, a protocol was established to model porous amorphous carbon surfaces based on a diamond-like structure for LiPS adsorption studies. AIMD simulations show that pore size and the inclusion of a heating ramp directly influence structural stability. The modeled surfaces exhibit high reactivity with strong interactions with LiPS, consistent with the experimental confinement effect, highlighting the need for surface passivation to better represent realistic conditions.
Acknowledgment
BATTERY 2030+
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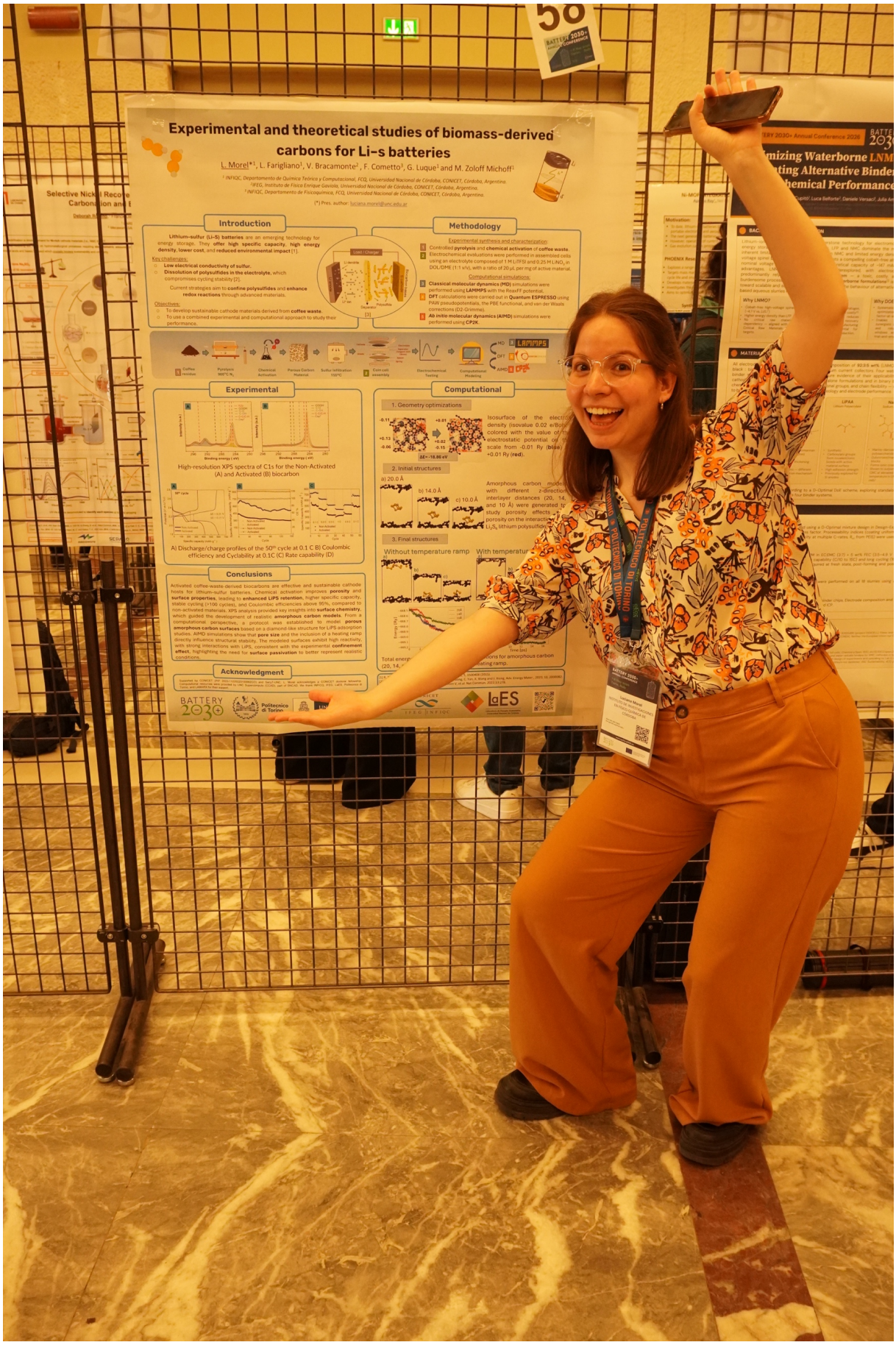
UNC
FCQ
CONICET
IFEG INFIQC
LaES
BATTERY 2030+ Annual Conference 2026
Optimizing Waterborne LNMO C
Evaluating Alternative Binders f
Electrochemical Performance an
BACKGROUND AND MOTIVATION
Why waterborne?
Why DOE?
CANDIDATES
Selective Nick Recover
Carbonation and E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Coin cell assembly
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A) Discharge/charge profiles of the 50th cycle at 0.1 C B) Coulombic efficiency and Cyclability at 0.1C (C) Rate capability (D)
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1. Geometry optimizations
ΔE= -18.96 eV
2. Initial structures
a) 20.0 Å
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Reducing the Environmental Impact of Lithium-Ion Batteries through High-Silicon Anodes: A Life Cycle Assessment
Introduction
Parameters
Life Cycle Inventory
Midpoint Impact Categories
Conclusions
4D computational characterization of lithium
CFD and PBM simulation
Introduction
Computational model


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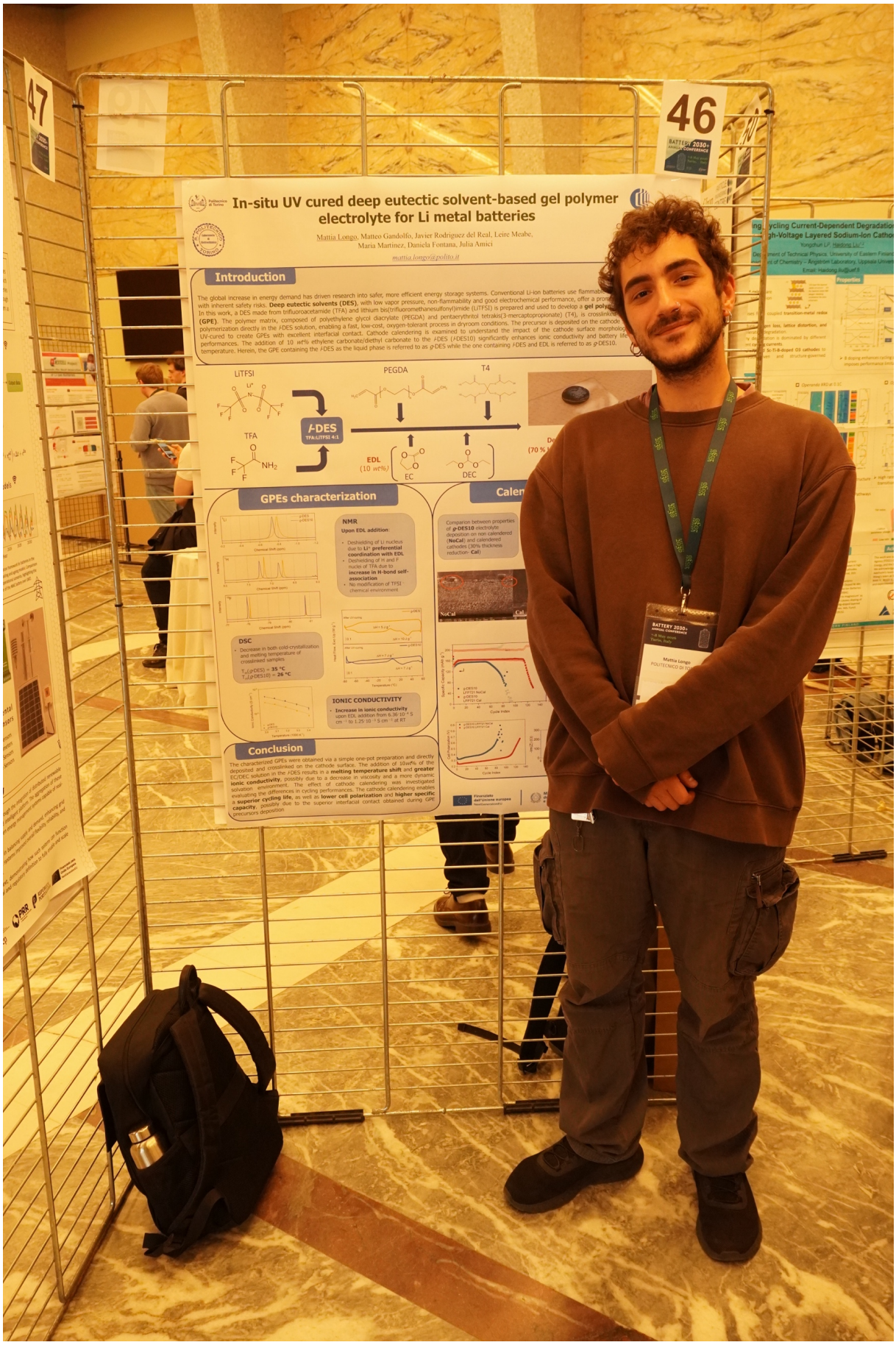
Experimental and theoretical studies of biomass-derived carbons for Li–s batteries
Introduction
Daniele Versaci
POLITECNICO DI TORINO
Luciana Morel
INSTITUTO DE INVESTIGACIONES EN FÍSICO-QUÍMICA DE CÓRDOBA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46
In-situ UV cured deep eutectic solvent-based gel polymer electrolyte for Li metal batteries
Mattia Longo, Matteo Gandolfo, Javier Rodriguez del Real, Leire Meabe, Maria Martinez, Daniela Fontana, Julia Amici
mattia.longo@polito.it
Introduction
The global increase in energy demand has driven research into safer, more efficient energy storage systems. Conventional Li-ion batteries use flammable
with inherent safety risks. Deep eutectic solvents (DES), with low vapor pressure, non-flammability and good electrochemical performance, offer a promi
In this work, a DES made from trifluoroacetamide (TFA) and lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) is prepared and used to develop a gel polyc
(GPE). The polymer matrix, composed of polyethylene glycol diacrylate (PEGDA) and pentaerythritol tetrakis(3-mercaptopropionate) (T4), is crosslinked
polymerization directly in the f-DES solution, enabling a fast, low-cost, oxygen-tolerant process in dryroom conditions. The precursor is deposited on the cathode
UV-cured to create GPEs with excellent interfacial contact. Cathode calendering is examined to understand the impact of the cathode surface morpholog
performances. The addition of 10 wt% ethylene carbonate/diethyl carbonate to the f-DES (f-DES10) significantly enhances ionic conductivity and battery life
temperature. Herein, the GPE containing the f-DES as the liquid phase is referred to as g-DES while the one containing f-DES and EDL is referred to as g-DES10.
LiTFSI
PEGDA
T4
TFA
f-DES
TFA:LiTFSI 4:1
EDL
(10 wt%)
EC
DEC
GPEs characterization
NMR
Upon EDL addition:
Deshielding of Li nucleus due to Li+ preferential coordination with EDL
Deshielding of H and F nuclei of TFA due to increase in H-bond self-association
No modification of TFSI chemical environment
DSC
Decrease in both cold-crystallization and melting temperature of crosslinked samples
Tc,g-DES) = 35 °C
Tc,g-DES10) = 26 °C
IONIC CONDUCTIVITY
Increase in ionic conductivity upon EDL addition from 6.36·10⁻⁴ S cm⁻¹ to 1.25·10⁻³ S cm⁻¹ at RT
Calen
Comparion between properties of g-DES10 electrolyte deposition on non calendered (NoCal) and calendered cathodes (30% thickness reduction- Cal)
NoCal
Cal
Conclusion
The characterized GPEs were obtained via a simple one-pot preparation and directly deposited and crosslinked on the cathode surface. The addition of 10wt% of the EC/DEC solution in the f-DES results in a melting temperature shift and greater ionic conductivity, possibly due to a decrease in viscosity and a more dynamic solvation environment. The effect of cathode calendering was investigated evaluating the differences in cycling performances. The cathode calendering enables a superior cycling life, as well as lower cell polarization and higher specific capacity, possibly due to the superior interfacial contact obtained during GPE precursors deposition
BATTERY 2030+
Mattia Longo
POLITECNICO DI TO
Cycling Current-Dependent Degradation
High-Voltage Layered Sodium-Ion Cathod
Properties


THE SMART SPECIALISATION STRATEGY
Digital transition
Green transition
Social-territorial impact
AEROSPACE
ADVANCED MANUFACTURING
MOBILITY
FOOD
GREEN TECHNOLOGIES
HEALTH
SMART SPECIALISATION STRATEGY
Application areas related to batteries
Components and systems for energy management, storage systems, for all types of vehicles and applications
Development of advanced manufacturing for the production and recovery of battery systems
Development of infrastructure for EV-based mobility and Battery Management Systems (smart charging, wireless charging, vehicle-to-grid integration, battery swap, resource optimization)
Development of storage systems for electric, hybrid and fuel cell vehicles
Technologies, materials, components and innovative solutions for the low and zero carbon hydrogen supply chain
Recovery and recycling of materials from WEEE


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Digital transition
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RdS
RICERCA DI SISTEMA
Why Storage Matters in Italy – PNIEC & the Grid Challenge
ENEA
RSE
Italy's Grid & Decarbonisation Challenges
High & fast-growing PV penetration
Italy ranks among EU leaders in solar capacity factor:
intraday over-generation already requires curtailment or storage.
Geographical imbalance North / South
Generation concentrated in the South (PV, wind);
loads and industry concentrated in the North → grid congestion.
Industrial load & electrification
Steel, chemicals, ceramics: high-temperature process heat;
mobility electrification adds new peak and flexibility demand.
Seasonal mismatch – LDES demand
Summer PV surplus vs. winter heating demand;
long-duration and seasonal storage essential for net-zero.
Resilience & energy sovereignty
Gas dependency reduction (REPowerEU);
domestic storage = strategic infrastructure, not just a grid tool.
+95 GWh
storage capacity needed by 2030 in Italy (Terna-GME)
48%
26%
Policy & Regulatory Framework
Fit for 55
-55% GHG by 2030
EU
Net Zero Industry Act
Strategic storage technologies
EU
Battery Regulation
LCA · CRM · Material passport
EU
Italian PNIEC
65% RES by 2030 · storage targets
IT
2050 Climate Neutrality
Full decarbonisation pathway
EU
Need for a diversified
storage portfolio
For Italy, storage is not only about balancing renewables – it is about system resilience, flexibility, sector coupling, industrial competitiveness and energy sovereignty.
PTR 25-27 · Progetto Integrato 1.2 · Accumulo Elettrochimico e Termico


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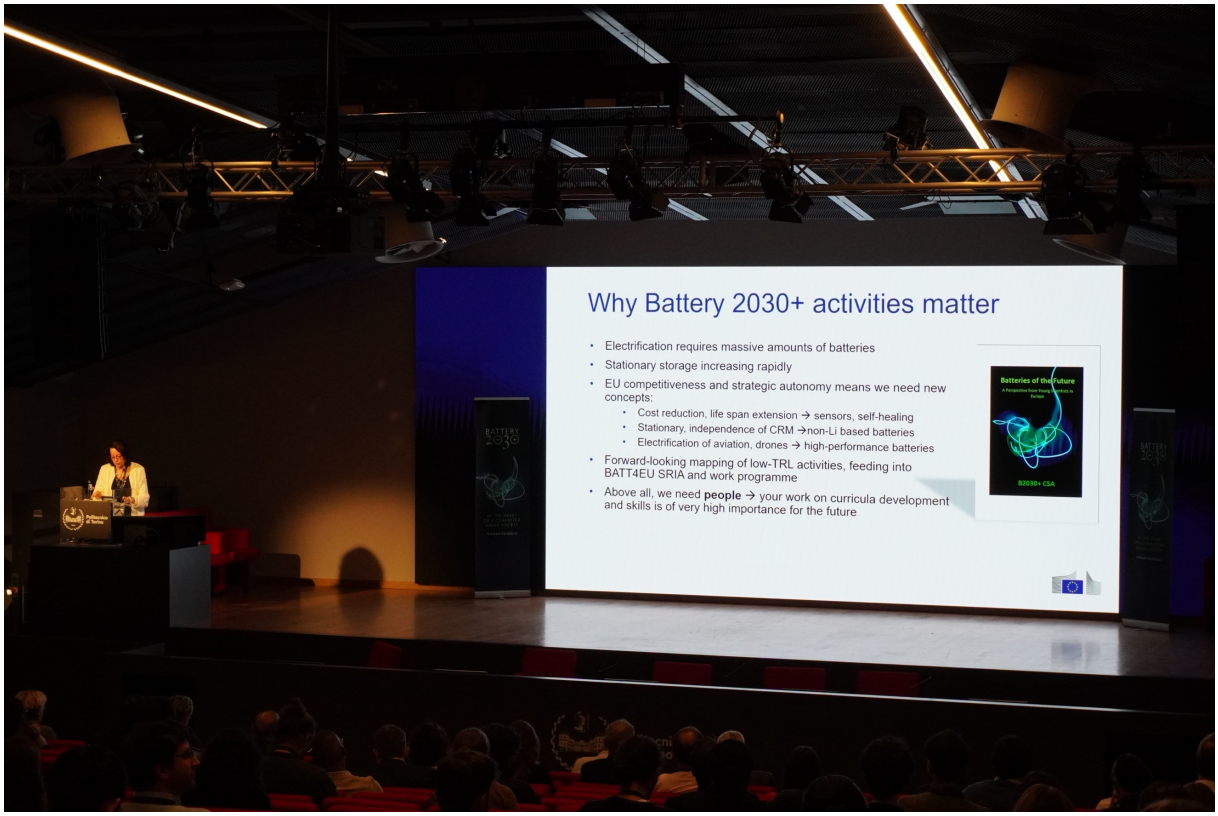
Italy's National Storage Ecosystem – Research Network & Coordination
PTR 25-27
Project 1.2
Consiglio Nazionale delle Ricerche
ENEA
RSE
National stakeholders:
>50 industries
universities and research organizations
consultancy, service, associations and agencies
International Links:
BATT4EU
EERA
EMIRI
BEPA
Batteries Europe
ETIP SNET
eucar
AMBP
BATTERY 2030+
Cluster Energia
IRENA
PTR 25-27: Progetto Integrato 1.2 - Accumuli Elettrochimico e Termico


Why Battery 2030+ activities matter
Electrification requires massive amounts of batteries
Stationary storage increasing rapidly
EU competitiveness and strategic autonomy means we need new concepts:
Cost reduction, life span extension → sensors, self-healing
Stationary, independence of CRM →non-Li based batteries
Electrification of aviation, drones → high-performance batteries
Forward-looking mapping of low-TRL activities, feeding into BATT4EU SRIA and work programme
Above all, we need people → your work on curricula development and skills is of very high importance for the future
Batteries of the Future
B2030+ CSA


EU battery-related policy
Battery Booster
EUR 1,5 Bn support, strong attention to R&I + skills
Industrial Accelerator Act
Made in Europe requirements for EV + BESS batteries
Conditions for Foreign Direct Investments
Clean Energy Investment Strategy
Access to finance to derisk energy generation technologies and long-duration storage
Electrification Action Plan
Expected in 2026, moving from 23% electrification rate to 32% by 2030
SET Plan
Development of SRIA, which will incorporate BATT2030+ inputs
Common Innovation Investment Plan, pooling R&I resources


The European Innovation Council is Europe's flagship innovation programme to identify, develop and scale up breakthrough technologies and game changing innovations.
Launch of the European Innovation Council
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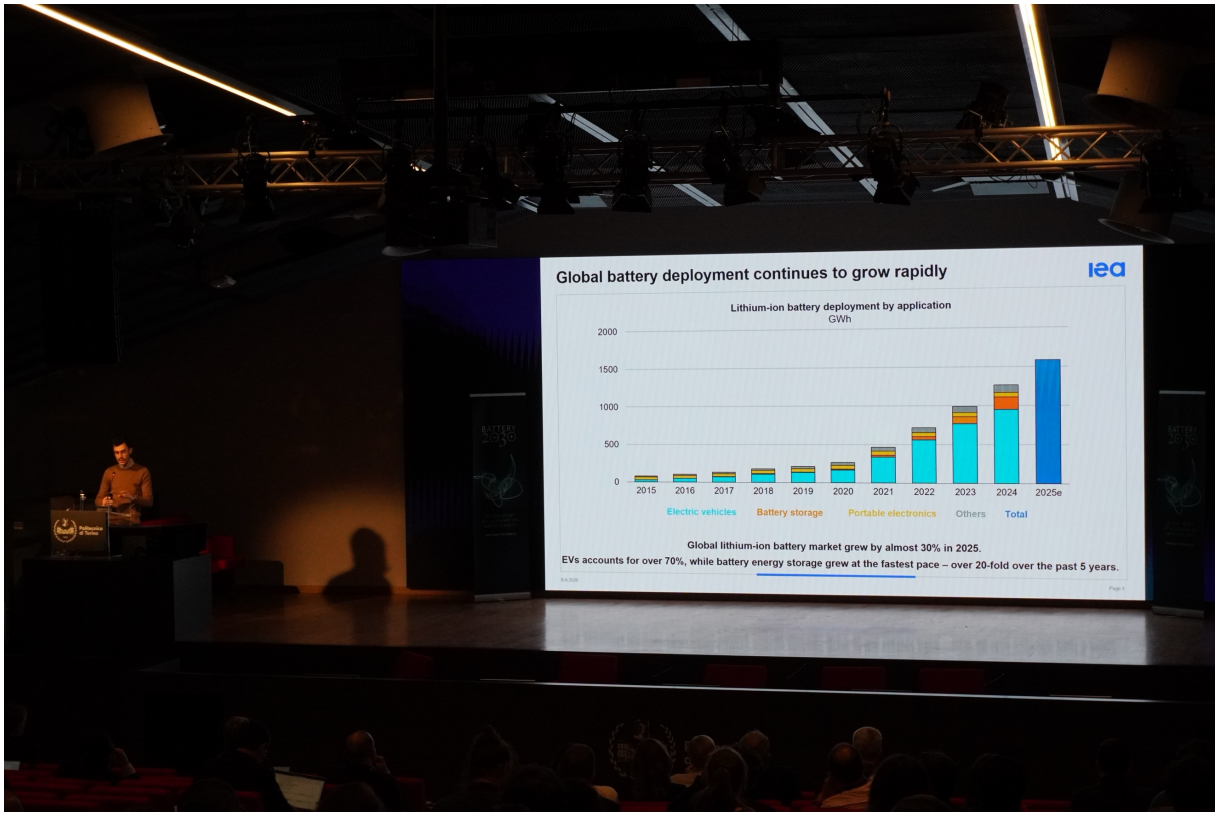
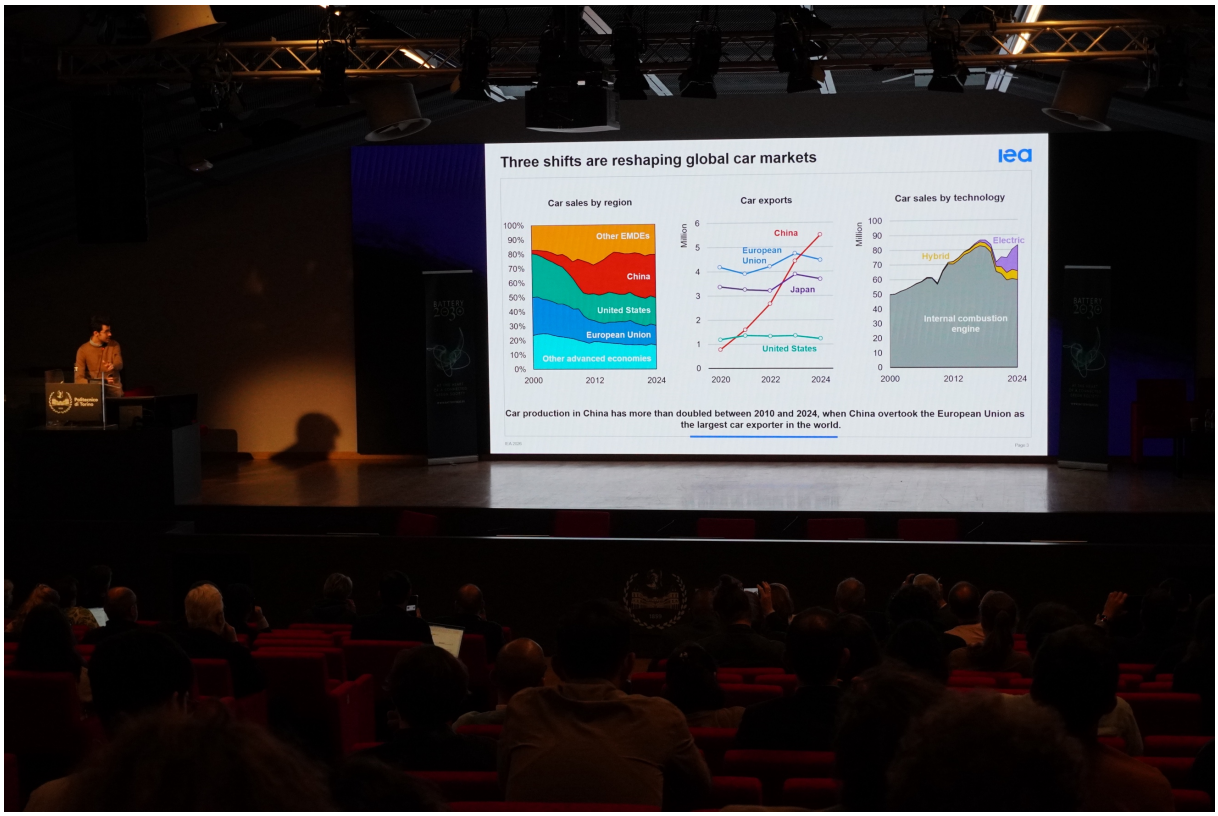
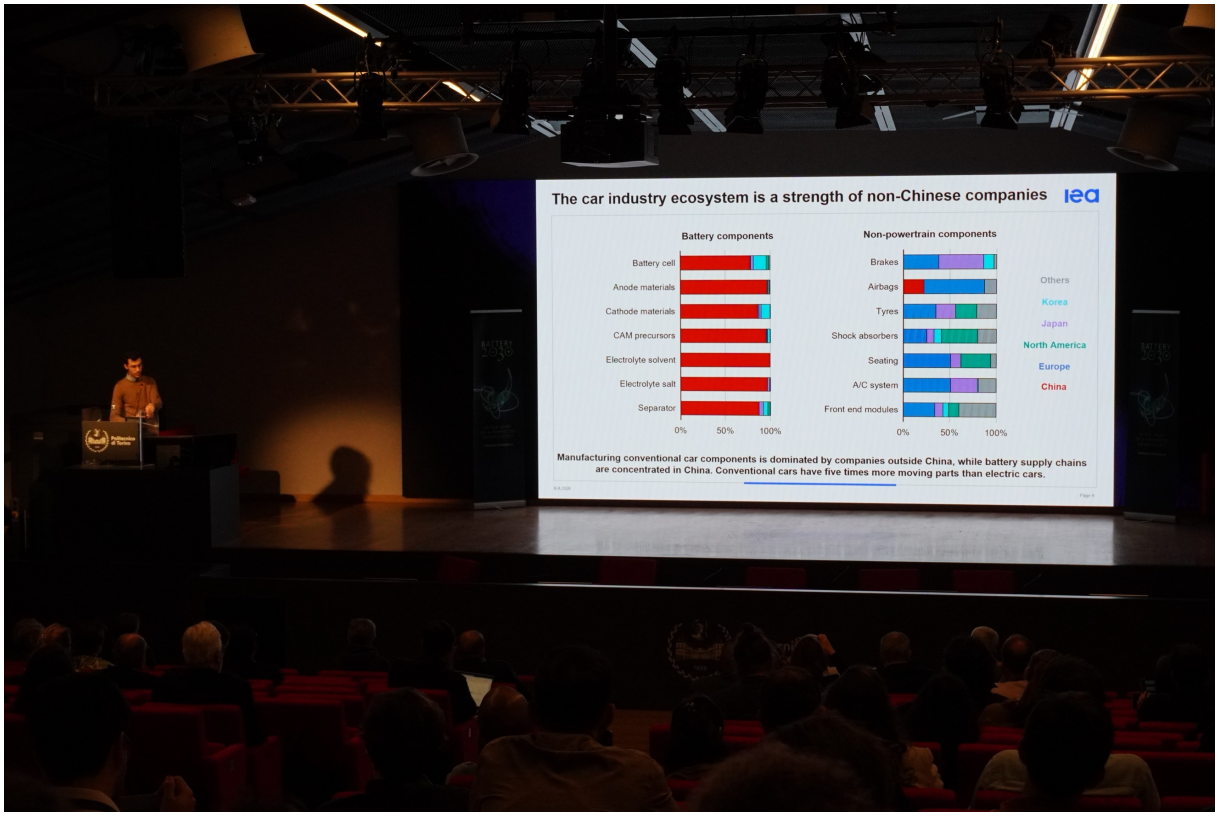
The future of European competitiveness
The future of European competitiveness: Report by Mario Draghi
reserach
Green Deal
Strategic autonomy
Raw Materials
RepowerEu
Accelerator
Equity
advanced materials
COMPETITIVINESS
EIC
Pathfinder
Innovation
energy harvesting
Start-up
EISMEA


Global battery deployment continues to grow rapidly
iea
Lithium-ion battery deployment by application
GWh
2000
1500
1000
500
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025e
Electric vehicles
Battery storage
Portable electronics
Others
Total
Global lithium-ion battery market grew by almost 30% in 2025.
EVs accounts for over 70%, while battery energy storage grew at the fastest pace – over 20-fold over the past 5 years.


Three shifts are reshaping global car markets
iea
Car sales by region
Other EMDEs
China
United States
European Union
Other advanced economies
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2000
2012
2024
Car exports
Million
China
European Union
Japan
United States
6
5
4
3
2
1
0
2020
2022
2024
Car sales by technology
Million
Electric
Hybrid
Internal combustion engine
100
90
80
70
60
50
40
30
20
10
0
2000
2012
2024
Car production in China has more than doubled between 2010 and 2024, when China overtook the European Union as the largest car exporter in the world.


The car industry ecosystem is a strength of non-Chinese companies
iea
Battery components
Battery cell
Anode materials
Cathode materials
CAM precursors
Electrolyte solvent
Electrolyte salt
Separator
0%
50%
100%
Non-powertrain components
Brakes
Airbags
Tyres
Shock absorbers
Seating
A/C system
Front end modules
0%
50%
100%
Others
Korea
Japan
North America
Europe
China
Manufacturing conventional car components is dominated by companies outside China, while battery supply chains are concentrated in China. Conventional cars have five times more moving parts than electric cars.


FAAM
ABOUT US
Teverola 1
• 300 MWh/year Capacity
• Soft Pouch Cell Format
• Water processing of LFP Electrodes
• High energy density applications with integrated BMS.
• €70M Investments
• Operating from Q4 of 2022
• Energy Storage Systems - Motive Power - Public transport - Naval and Defense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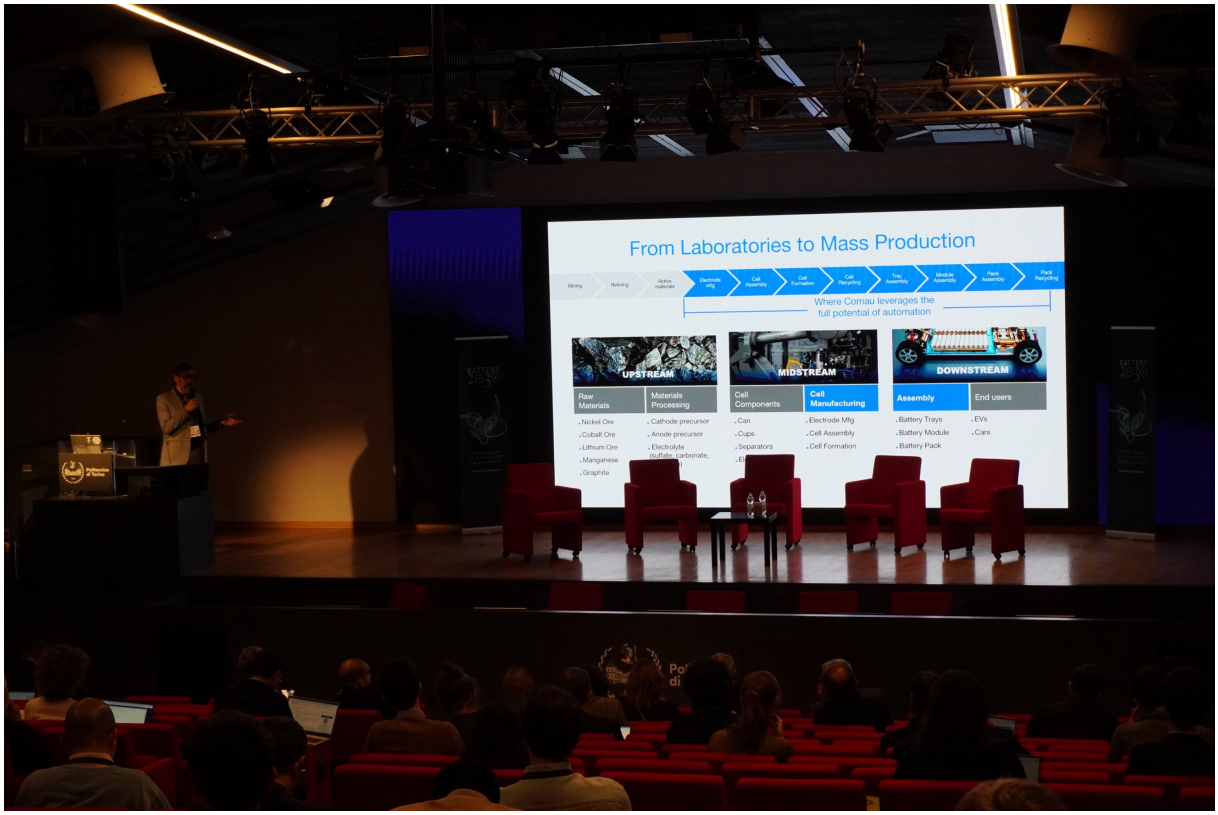
FAAM
ABOUT US
Teverola 2
• 8 GWh/year Capacity
• Prismatic Cell Format
• LFP-Graphite, Na-ion, and Gen4 Batteries
• Recycling Pilot Line with 50 ton/day Capacity
• €505M Investments (fully funded by IPCEI)
• Operating by 2027
• Energy Storage Systems – Motive Power – Public transport – Special Applications


From Laboratories to Mass Production
Mining
Refining
Active materials
Electrode Mfg
Cell Assembly
Cell Formation
Cell Recycling
Tray Assembly
Module Assembly
Pack Assembly
Pack Recycling
Where Comau leverages the full potential of automation
UPSTREAM
MIDSTREAM
DOWNSTREAM
Raw Materials
Materials Processing
Cell Components
Cell Manufacturing
Assembly
End users
Nickel Ore
Cobalt Ore
Lithium Ore
Manganese
Graphite
Cathode precursor
Anode precursor
Electrolyte (sulfate, carbonate,
Can
Cups
Separators
Electrode Mfg
Cell Assembly
Cell Formation
Battery Trays
Battery Module
Battery Pack
EVs
Cars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DAY 2
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ANNUAL CONFERENCE
7-8 May 2026
Turin Italy
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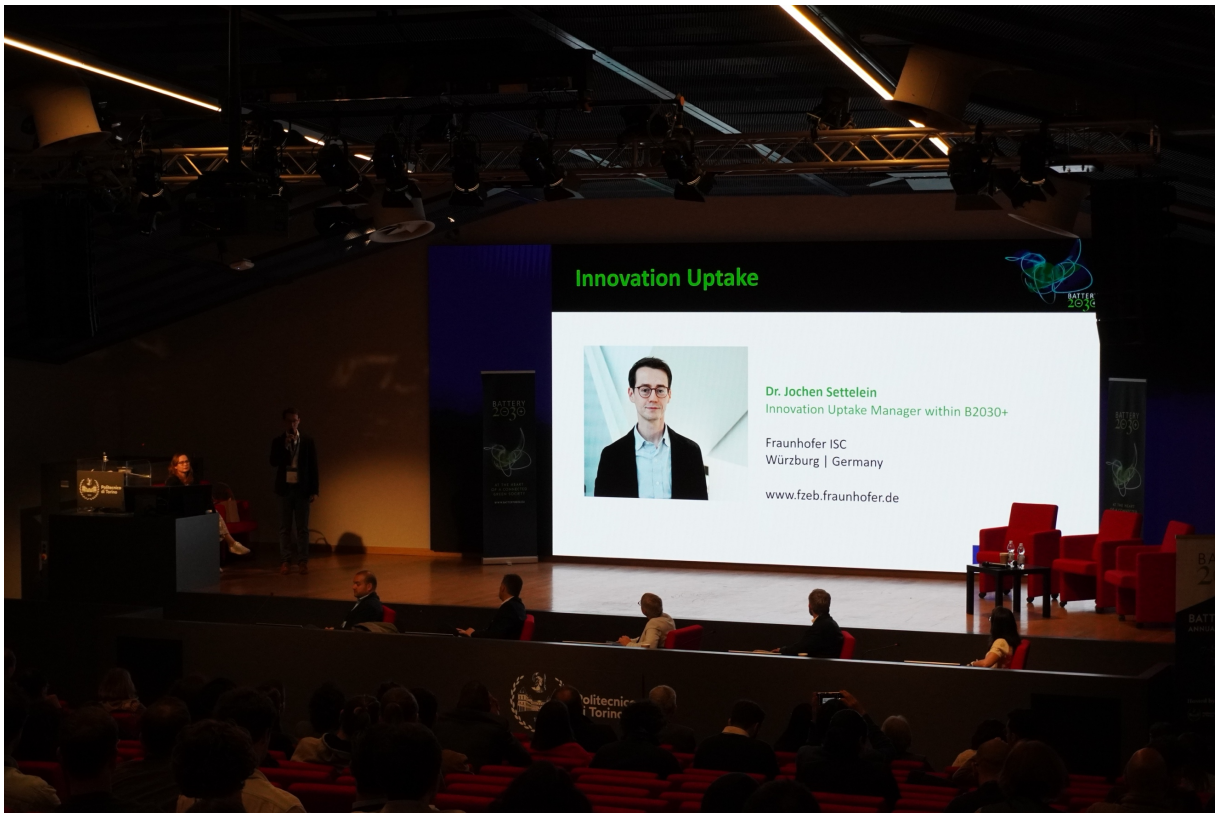
Why is this so?


BATTERY 2030
DON'T BORE PEOPLE!
CHOOSE YOUR WAY OF STORYTELLING WISELY
Scientific funnel
Storytelling pyramid
For your peers
For everyone else


Innovation Uptake
Dr. Jochen Settelein
Innovation Uptake Manager within B2030+
Fraunhofer ISC
Würzburg | Germany
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TAKE YOUR IDEA TO THE NEXT LEVEL!
YOUNG SCIENTISTS COMPETITION
Battery 2030+ YOUNG SCIENTISTS competition
11:50 – 12:10 3 Scientific Talks à 6 min Contestants
12:10 – 12:25 Jury feedback and questions Jury
12:25 – 12:45 3 Scientific Talks à 6 min Contestants
12:45 – 13:00 Jury feedback and questions Jury
Evaluation criteria:
Performance: Confidence & storytelling
Credibility: Expertise & trustworthiness
Structure: Clarity & logic
Awards:
Jury
Audience
Ceremony


Synchrotron as a radiation facility:
what is a Synchrotron?
A synchrotron is a particle accelerator where particles travel around many times in a circle.
Synchrotron can be a Light Source
to investigate the structure of matter
Bremsstrahlung effect
By exploiting the unique properties of synchrotron light
es. Continuum spectrum from terahertz to hard X-rays and even gamma rays
high brilliance a vast range of characterization methods becomes available
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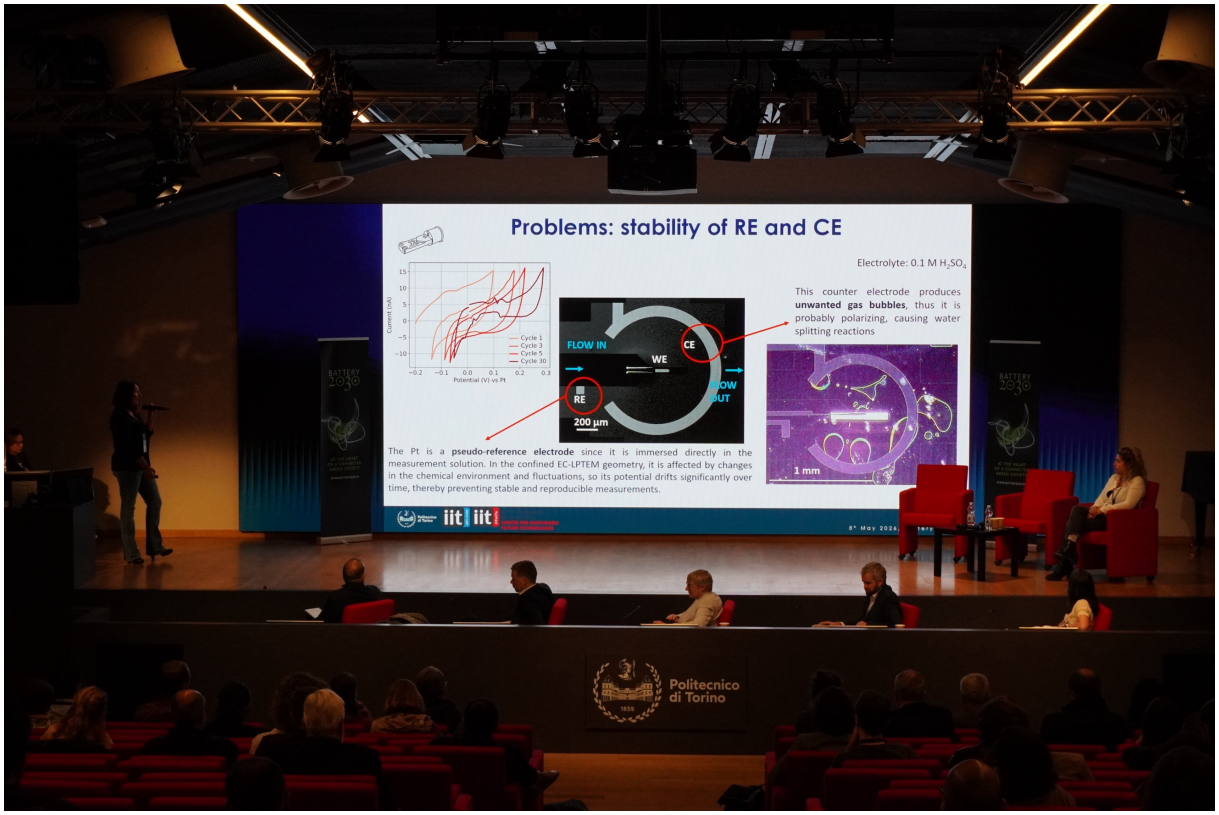
Problems: stability of RE and CE
Electrolyte: 0.1 M H_2SO_4
Cycle 1
Cycle 3
Cycle 5
Cycle 30
Potential (V) vs Pt
FLOW IN
WE
CE
RE
200 µm
This counter electrode produces unwanted gas bubbles, thus it is probably polarizing, causing water splitting reactions
1 mm
The Pt is a pseudo-reference electrode since it is immersed directly in the measurement solution. In the confined EC-LPTEM geometry, it is affected by changes in the chemical environment and fluctuations, so its potential drifts significantly over time, thereby preventing stable and reproducible measurements.
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Solution: increase the ESA
1 mm
Nanostructuration increases the electroactive surface area of the RE and CE.
Molecular-template-assisted electrodeposition of nanostructured Pd on existing electrodes, is able to work in multiple electrochemical regimes. The Pd thin films significantly increase the electroactive surface area (ESA) while preserving the specific electrode geometry.
With this strategy:
✓ the CE larger ESA minimises its polarization during operation (thus reducing the possibility to loose ionic contact)
✓ the RE nanostructuration improves its stability over time
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Solution: increase the ESA
1 mm
200 nm
Nanostructured Pd
500 nm
Nanostructuration increases the electroactive surface area of the RE and CE
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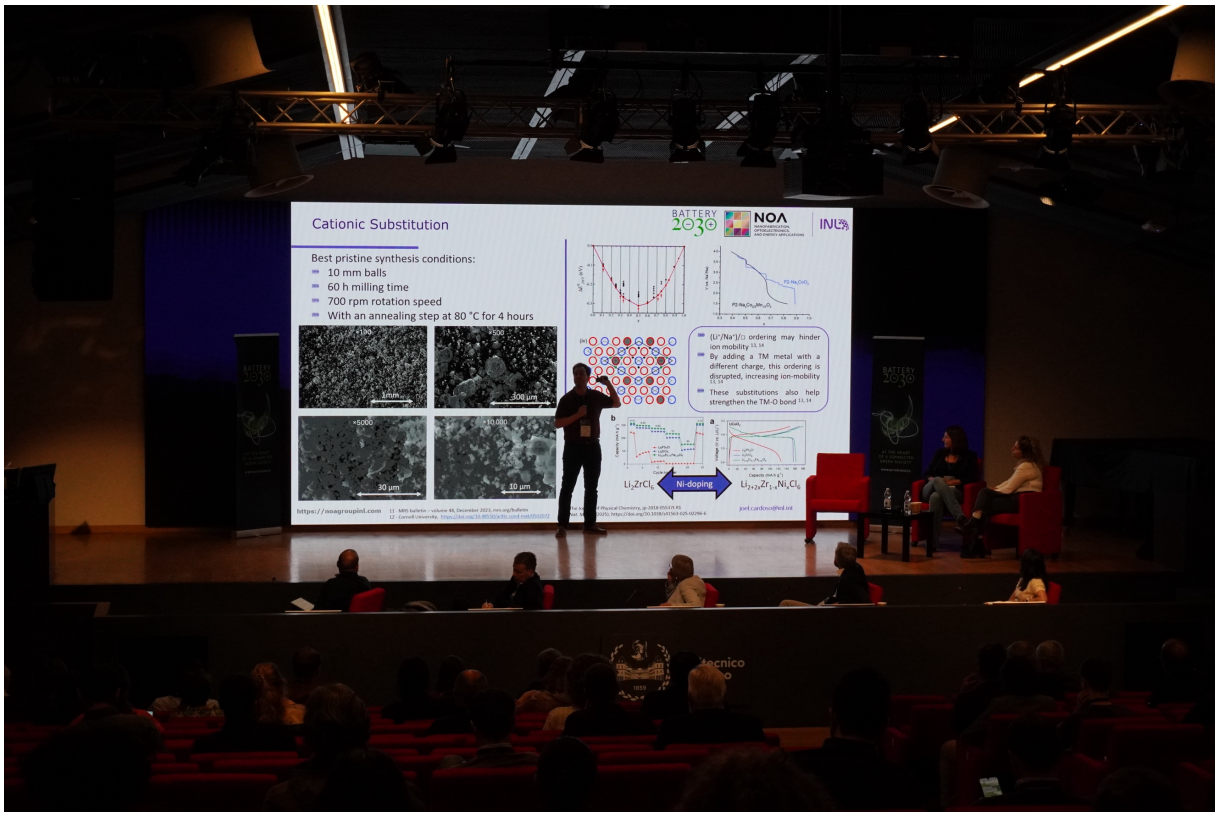
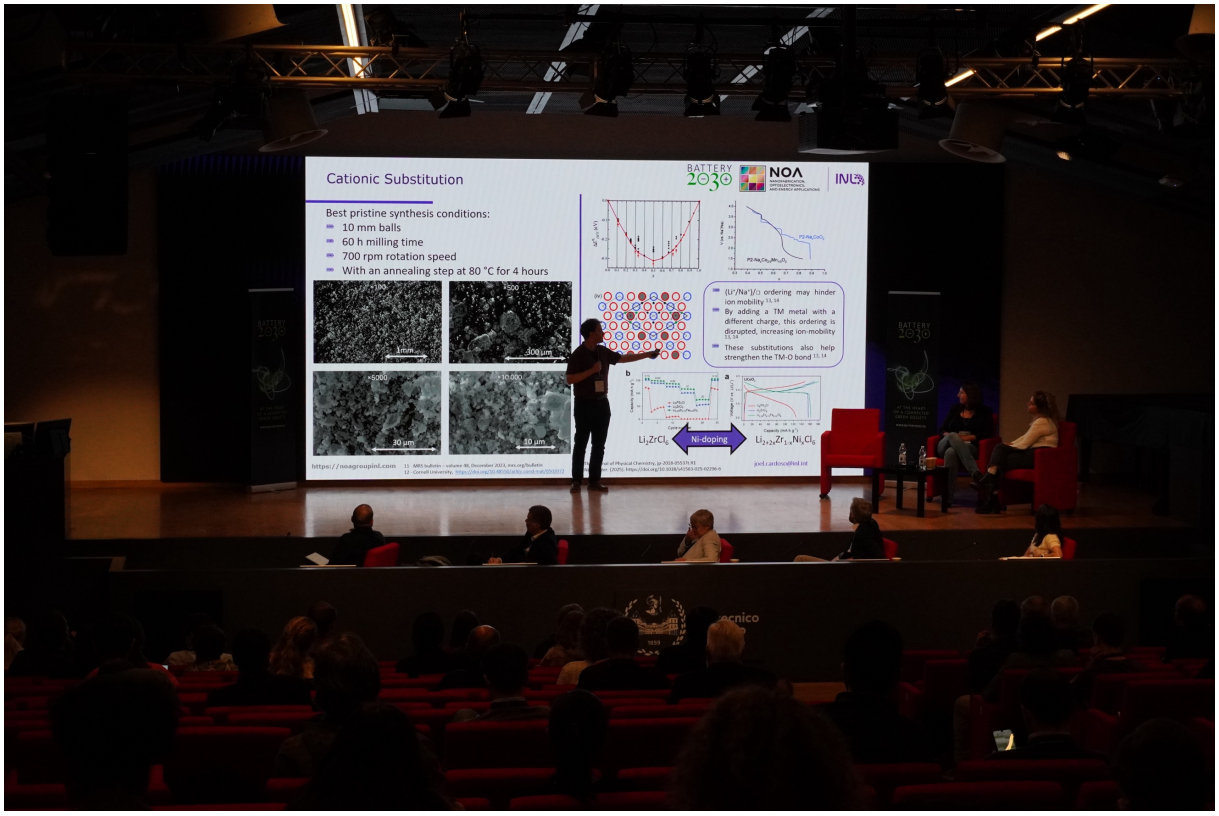

Cationic Substitution
BATTERY 2030
NOA
INL
Best pristine synthesis conditions:
10 mm balls
60 h milling time
700 rpm rotation speed
With an annealing step at 80 °C for 4 hours
(Li+/Na+)/□ ordering may hinder ion mobility [13, 14]
By adding a TM metal with a different charge, this ordering is disrupted, increasing ion-mobility [13, 14]
These substitutions also help strengthen the TM-O bond [13, 14]
Li3ZrCl6
Ni-doping
Li2+2xZr1-xNixCl6
https://noagroupinl.com
joel.cardoso@inl.int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Jury feedback
and Questions
Audience Voting
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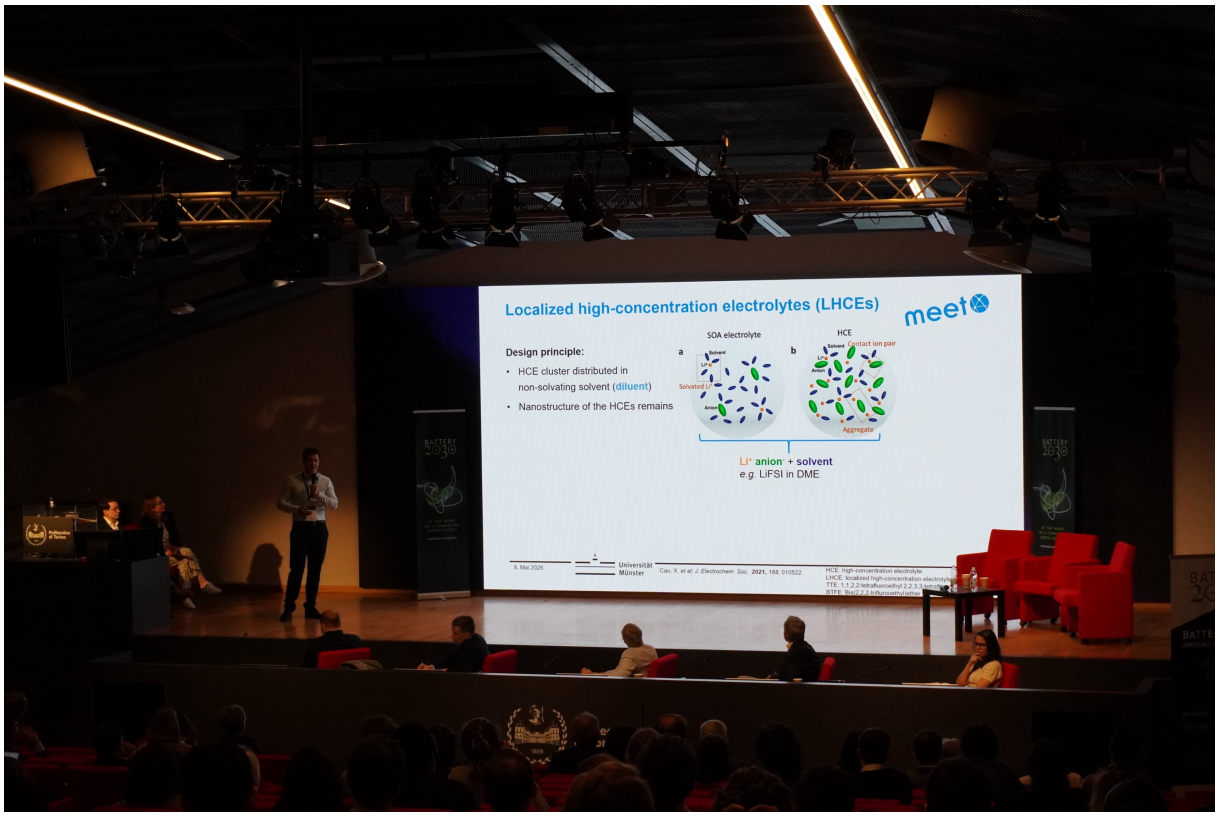
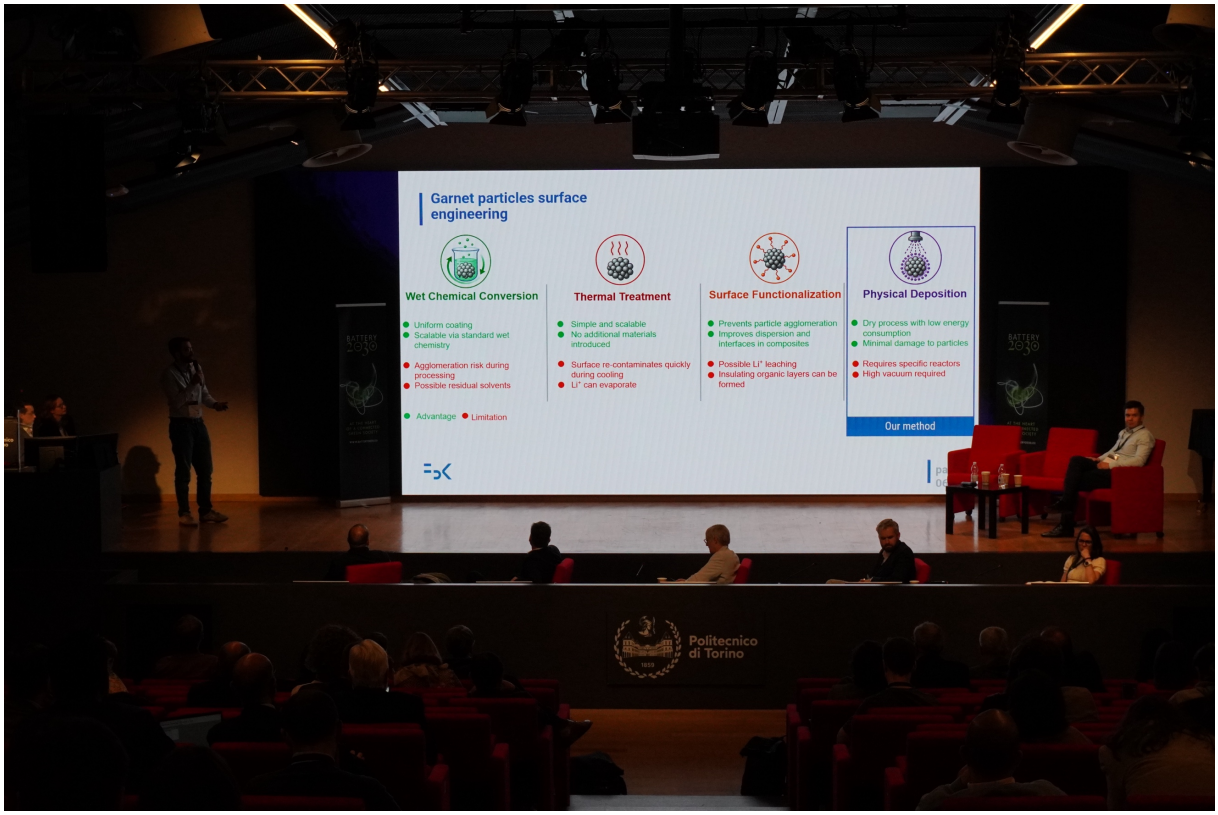

Localized high-concentration electrolytes (LHCEs)
meet
Design principle:
• HCE cluster distributed in non-solvating solvent (diluent)
• Nanostructure of the HCEs remains
SOA electrolyte
HCE
Contact ion pair
Solvated Li
Aggregate
Li⁺ anion + solvent
e.g. LiFSI in DME
Universität Münster


Garnet particles surface engineering
Wet Chemical Conversion
Uniform coating
Scalable via standard wet chemistry
Agglomeration risk during processing
Possible residual solvents
Thermal Treatment
Simple and scalable
No additional materials introduced
Surface re-contaminates quickly during cooling
Li⁺ can evaporate
Surface Functionalization
Prevents particle agglomeration
Improves dispersion and interfaces in composites
Possible Li⁺ leaching
Insulating organic layers can be formed
Physical Deposition
Dry process with low energy consumption
Minimal damage to particles
Requires specific reactors
High vacuum required
Our method
Advantage
Limitation
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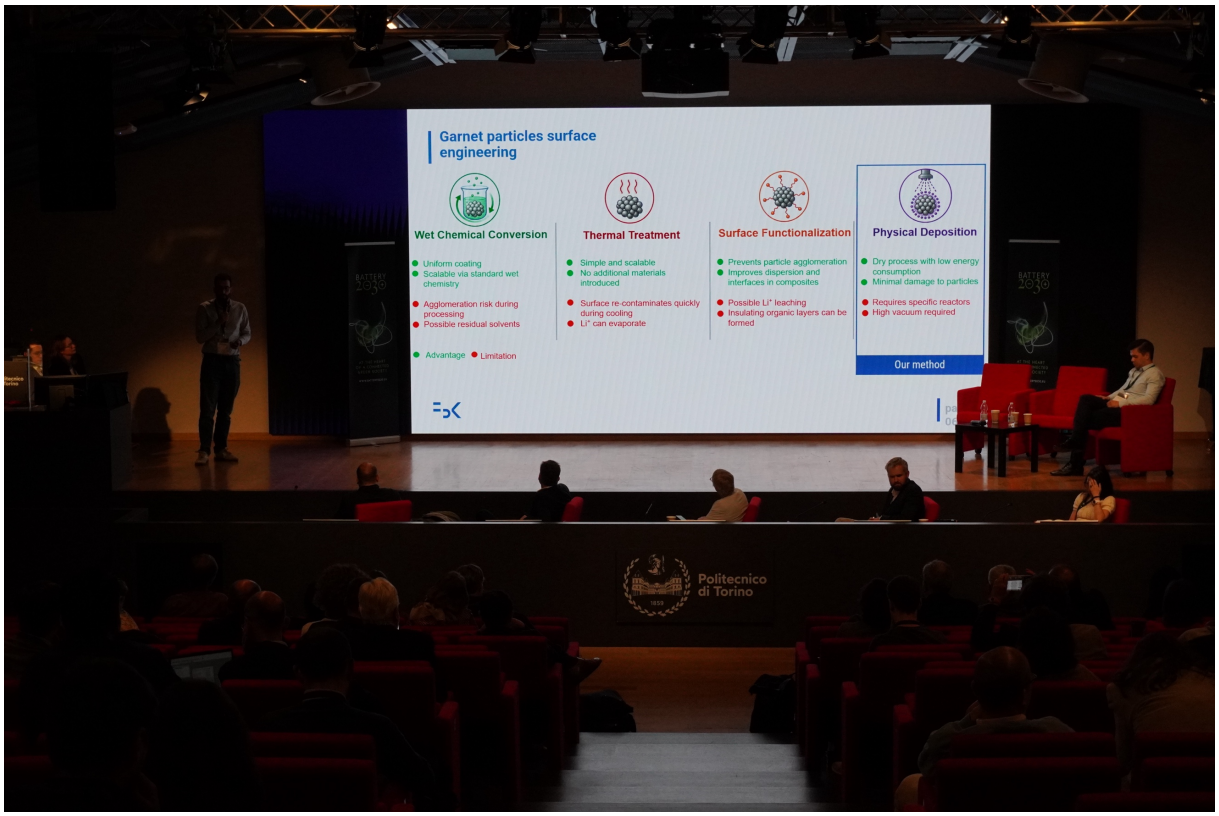
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Physical Deposition
Dry process with low energy consumption
Minimal damage to particles
Requires specific reactors
High vacuum required
Our method
Advantage
Limitation
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Do we have the whole picture?
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Do we have the whole picture?
• A lot known about a cell's environmental impacts
– Chemistry, form factor, production, etc.
• The rest-of-pack is almost forgotten in LCA literature?
– Main data source is from 2014 (!)
– New designs evolving (cell-to-pack, cell-to-chassis, etc.)
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Jury feedback and Questions
Audience Voting


Jury feedback
and Questions
Audience Voting
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57
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BATTERY 2030
Optimizing Waterborne LNMO Cathode Production: Evaluating Alternative Binders for Enhanced Electrochemical Performance and Processability
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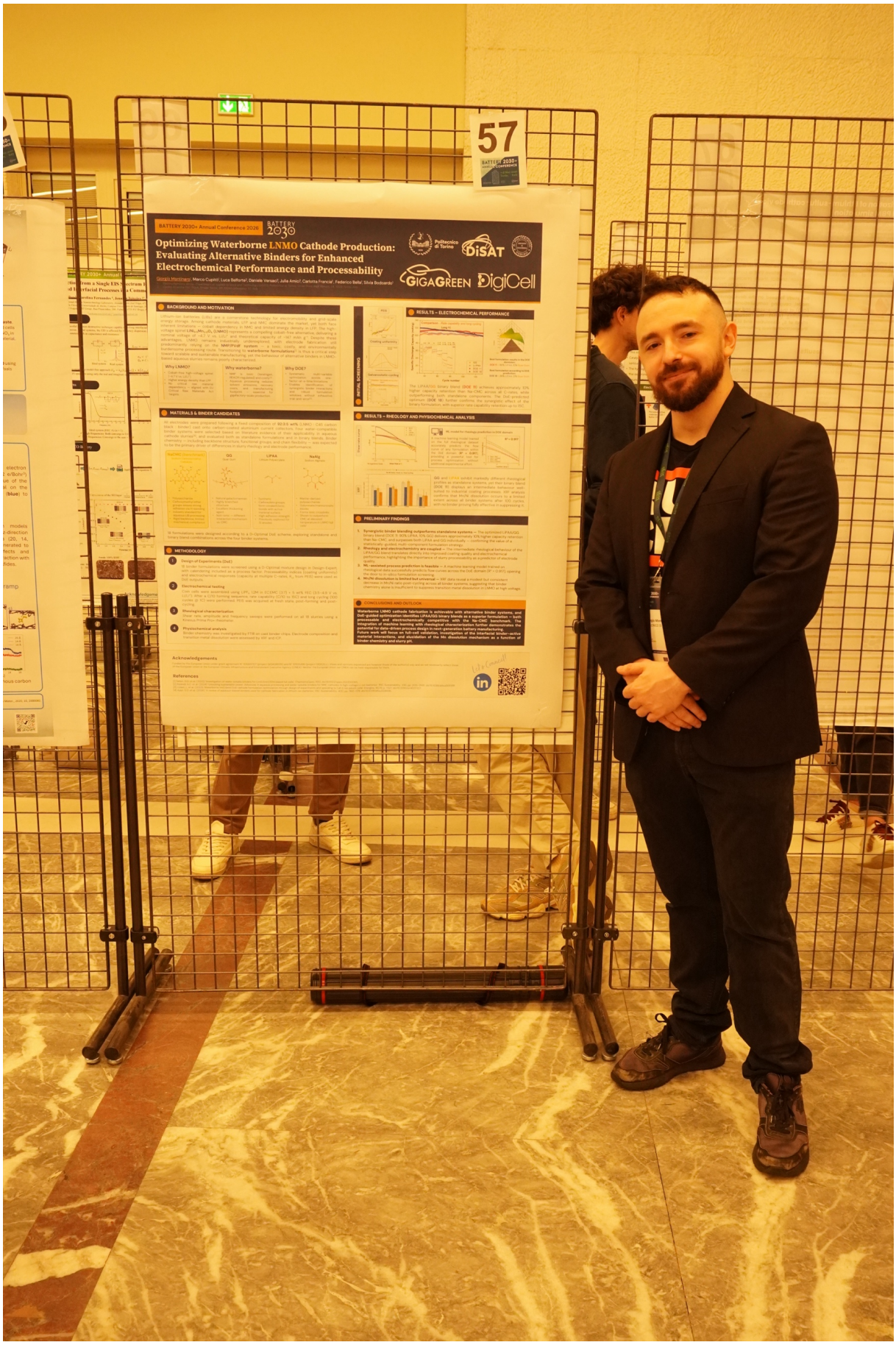
DISAT
GIGAGREEN
DigiCell
BACKGROUND AND MOTIVATION
MATERIALS & BINDER CANDIDATES
METHODOLOGY
RESULTS – ELECTROCHEMICAL PERFORMANCE
RESULTS – RHEOLOGY AND PHYSICOCHEMICAL ANALYSIS
PRELIMINARY FINDINGS
CONCLUSIONS AND OUTLOOK
Acknowledgements
References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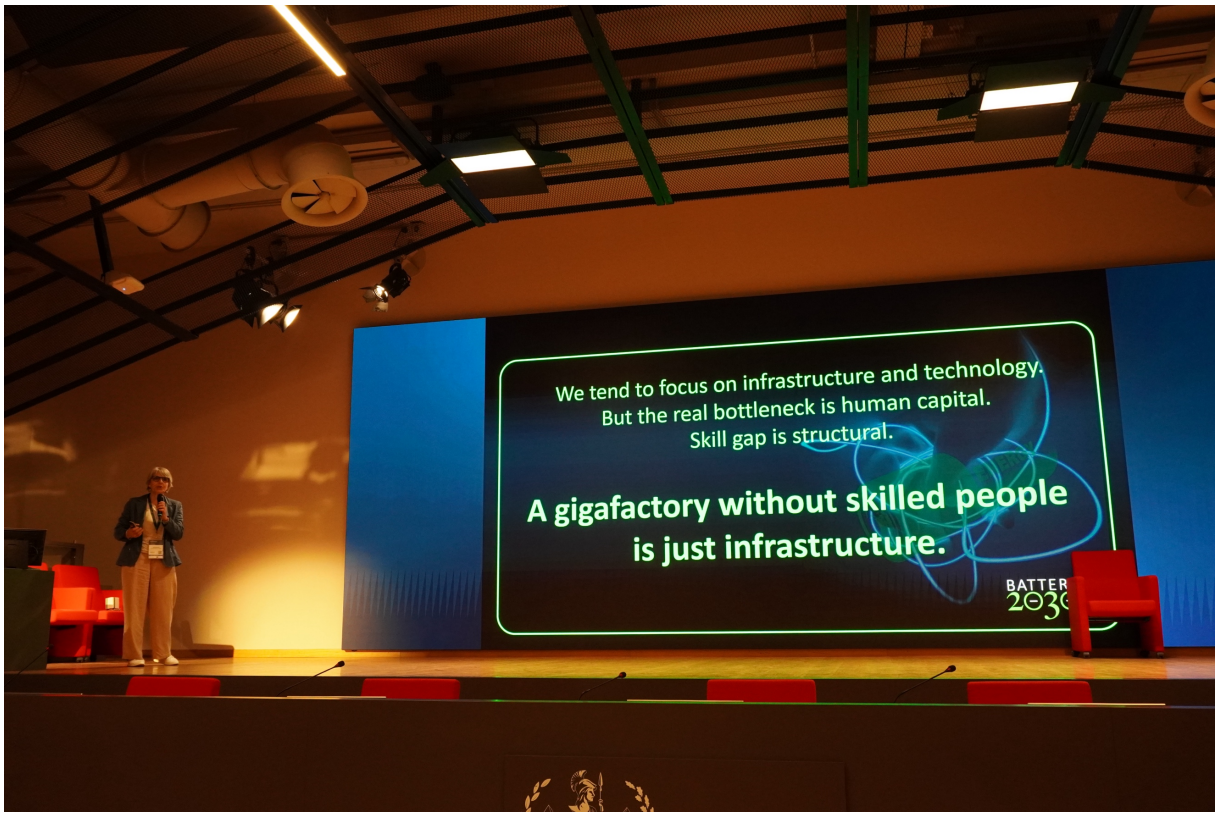
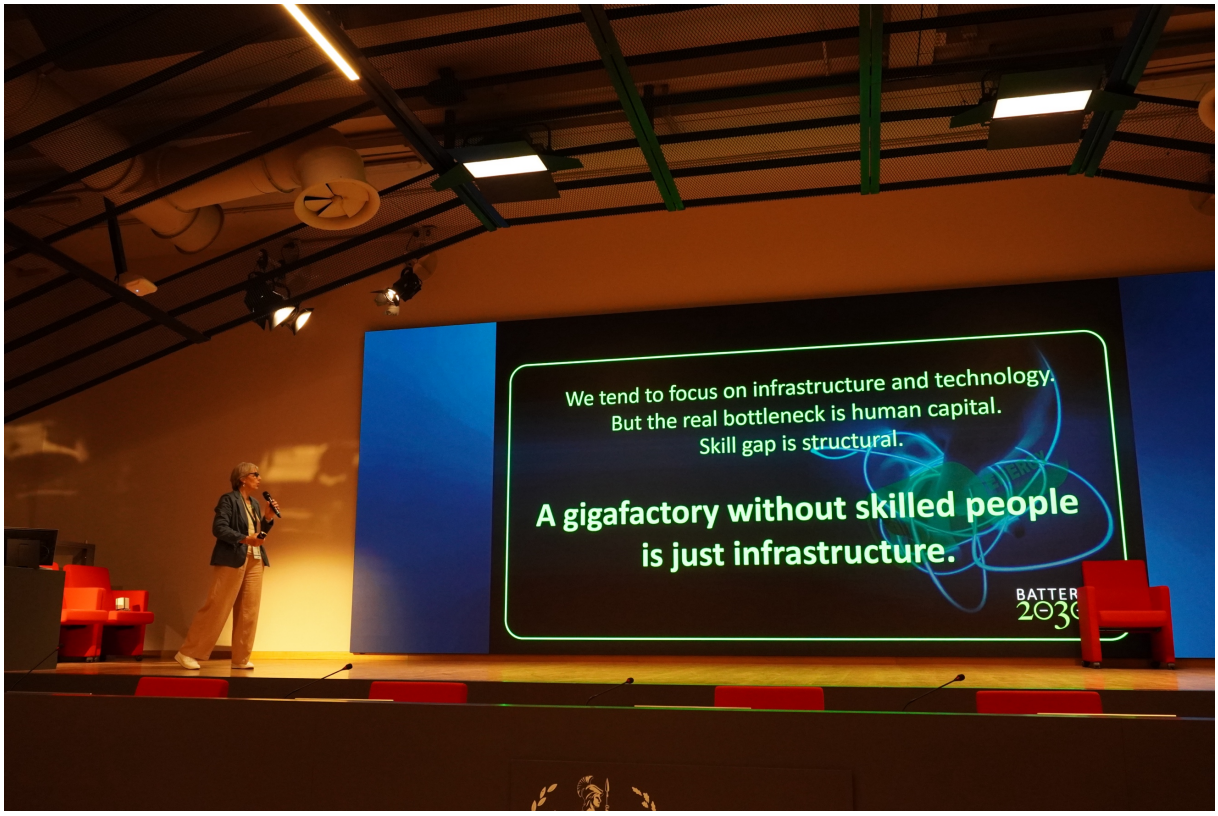

We tend to focus on infrastructure and technology.
But the real bottleneck is human capital.
Skill gap is structural.
A gigafactory without skilled people
is just infrastructure.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We tend to focus
But the real
Sk
A gigafactory
is just
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Digitalization of Education for the European Battery Eco-System
•Educational efforts on data standardisation, data handling, fair data, ontology
•"Train the trainers" on the topics in the BATTERY2030+ roadmap
MOOC
Education without borders
BUT... NEVER FORGET HANDS ON EDUCATION
5-Star Battery Data Introduction
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The Young Scientists Community
BATTERY 2030+
Founded in May 2024 at the Battery2030+ annual conference in Grenoble.
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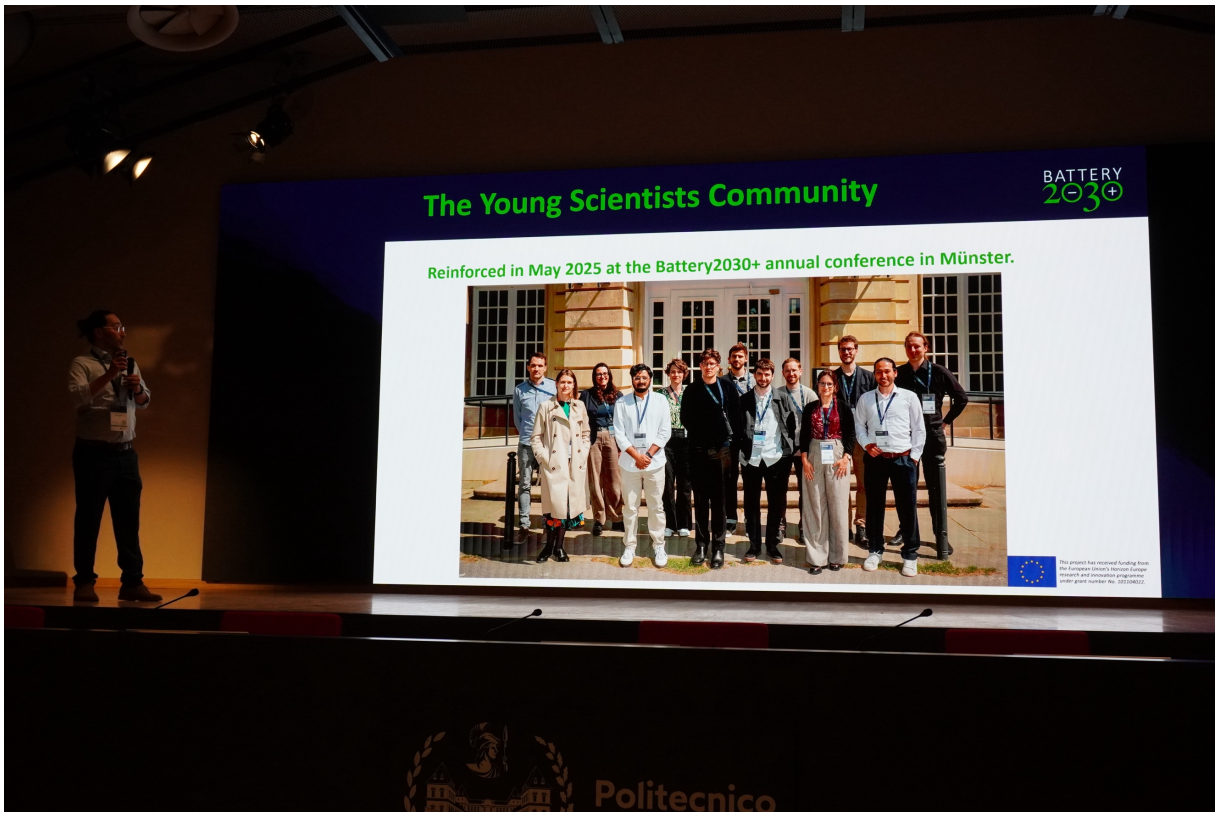
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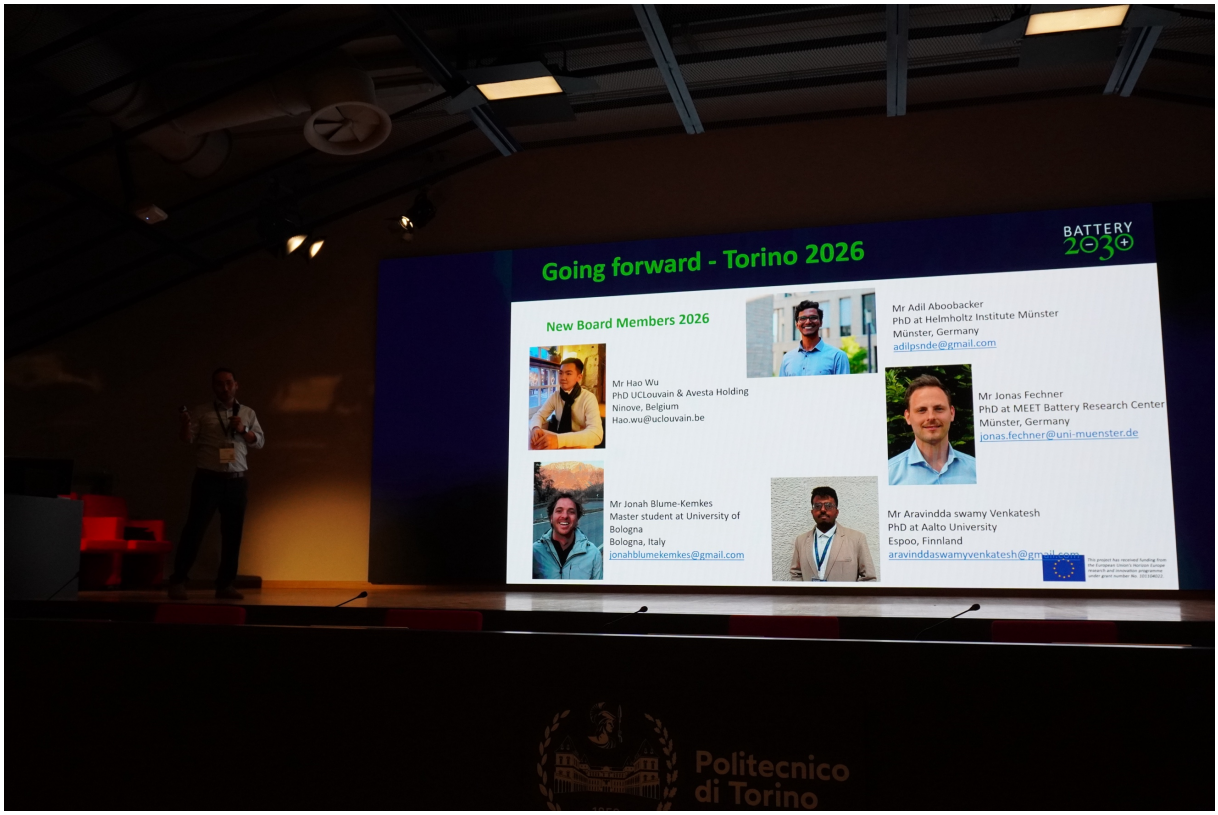
Going forward - Torino 2026
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New Board Members 2026
Mr Hao Wu
PhD UCLouvain & Avesta Holding
Ninove, Belgium
Hao.wu@uclouvain.be
Mr Adil Aboobacker
PhD at Helmholtz Institute Münster
Münster, Germany
adilpsnde@gmail.com
Mr Jonas Fechner
PhD at MEET Battery Research Center
Münster, Germany
jonas.fechner@uni-muenster.de
Mr Jonah Blume-Kemkes
Master student at University of Bologna
Bologna, Italy
jonahblumekemkes@gmail.com
Mr Aravindda swamy Venkatesh
PhD at Aalto University
Espoo, Finnland
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Coordinating and strenghten European research activities in the field of energy storage
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We connect people, insitutions and initiatives across Europe to build a strong ecosystem of energy storage research.
STRATEGY & POLICY INTERFACE
We contribute to European startegies and policies and represent the voice of energy storage research.
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We improve access to research infrastructures, optimize their use and support their long-term development.
INNOVATION & IMPACT
We turn research into impact and help deliver solutions for a sustainable, resilient energy system in Europe.
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Foster collaboration among leading research institutions across Europe
Coordinate European research activities in the field of energy storage
Stronger together for Europe's energy future
FROM IDEA TO IMPACT: EU-FUNDED PROJECTS
IDEA & CONCEPT
Identifying needs, opportunities and partners
DESIGN & DEVELOP
Building strong consortia and designing projects
IMPLEMENT
Managing projects and coordinating activities
RESULTS & IMPACT
Delivering outcomes, sharing knowledge and creating value
ONGOING PROJECT
RISEnergy
PAST PROJECTS
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OUR IMPACT
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Enabling world-class research infrastructures that drive innovation and competitiveness.
Contributing to sustainable, resilient and secure energy systems for Europe and beyond.
Bringing together top research institutions from across Europe, covering the full energy storage value chain.
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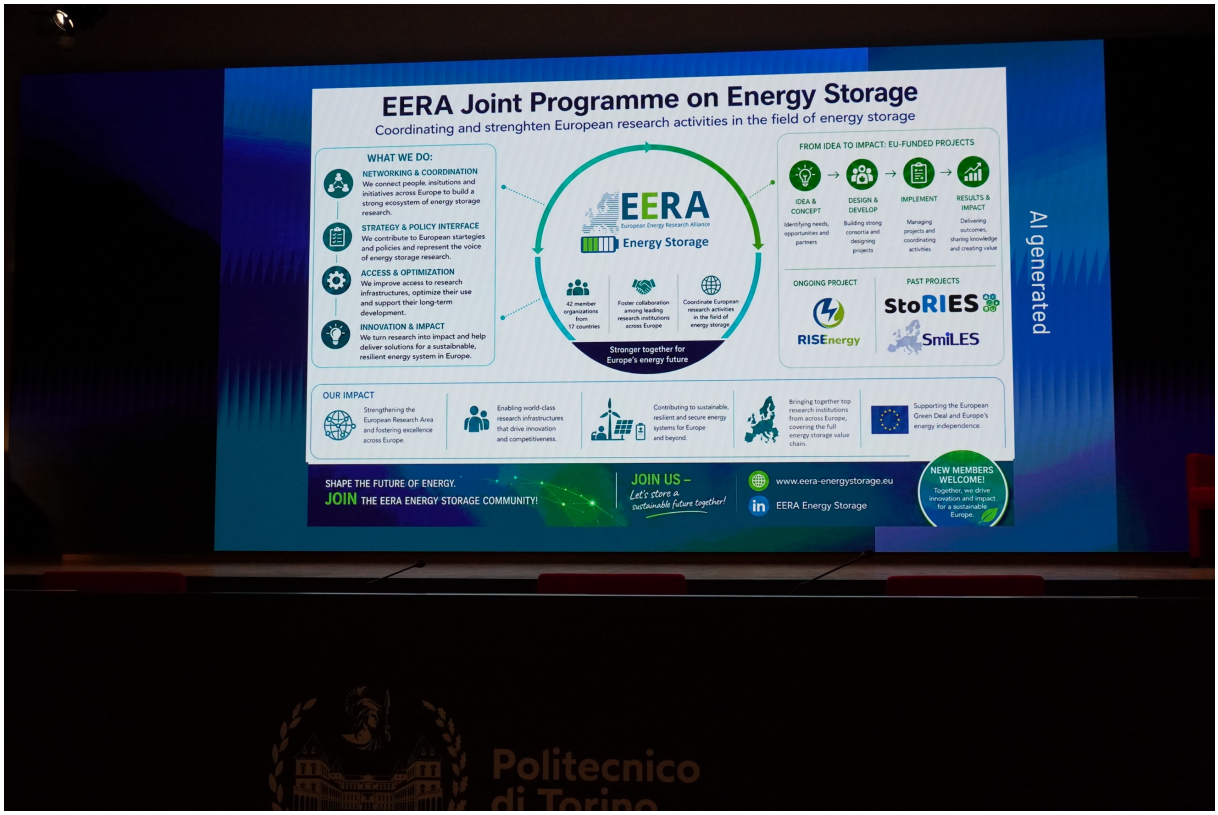
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Best Innovation Pitch
Jury Award
goes to
Silvan Stuckenberg
This reward
worth 2000€ is
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Best Poster - Jury Award
2nd place goes to
Davide Calzari
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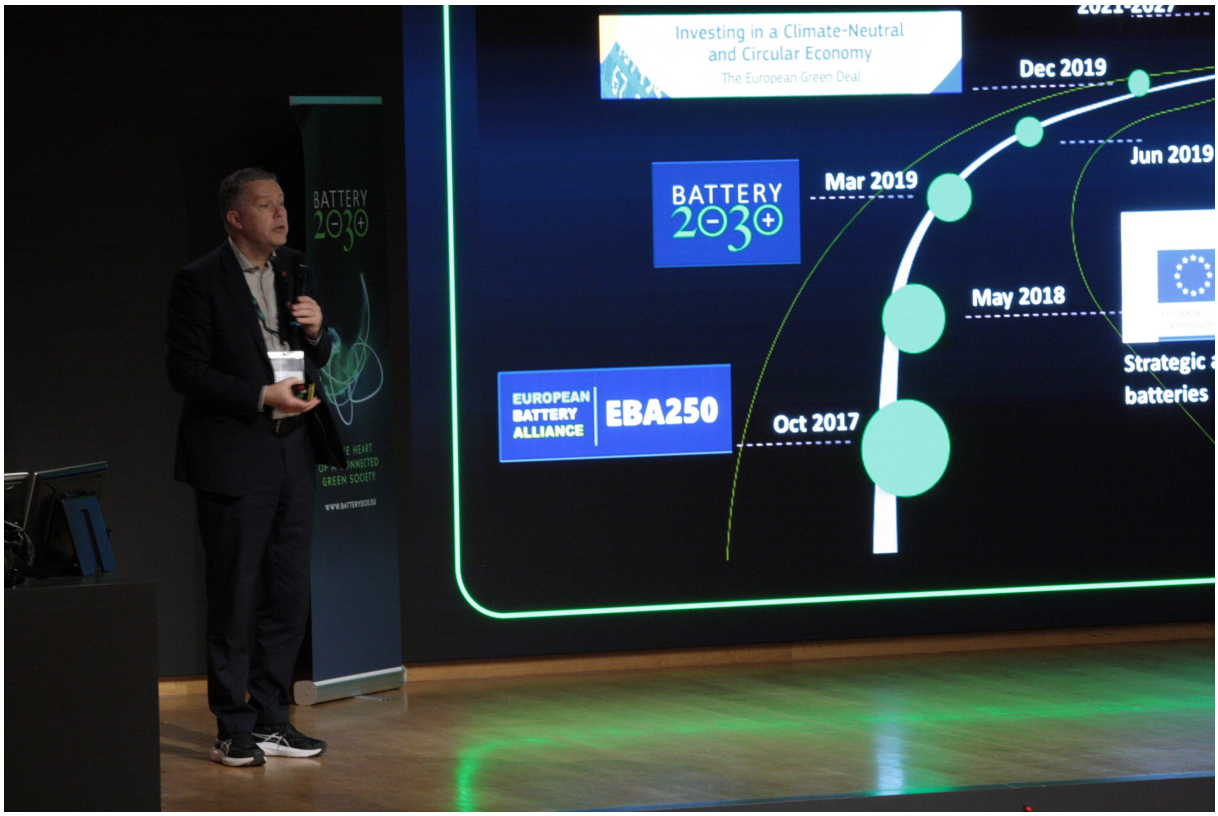
Investing in a Climate-Neutral
and Circular Economy
The European Green Deal
Dec 2019
Jun 2019
BATTERY 2030+
Mar 2019
May 2018
EUROPEAN BATTERY ALLIANCE
EBA250
Oct 2017
Strategic
batteries


Welcome!
April 27th 2026
Kristina Edström being awarded
"l'Ordre des Palmes Académiques"
by the French Ministry of Education
BATTERY 2030+


Welcome!
April 27th 2026
Kristina Edström being awarded
"l'Ordre des Palmes Académiques"
by the French Ministry of Education
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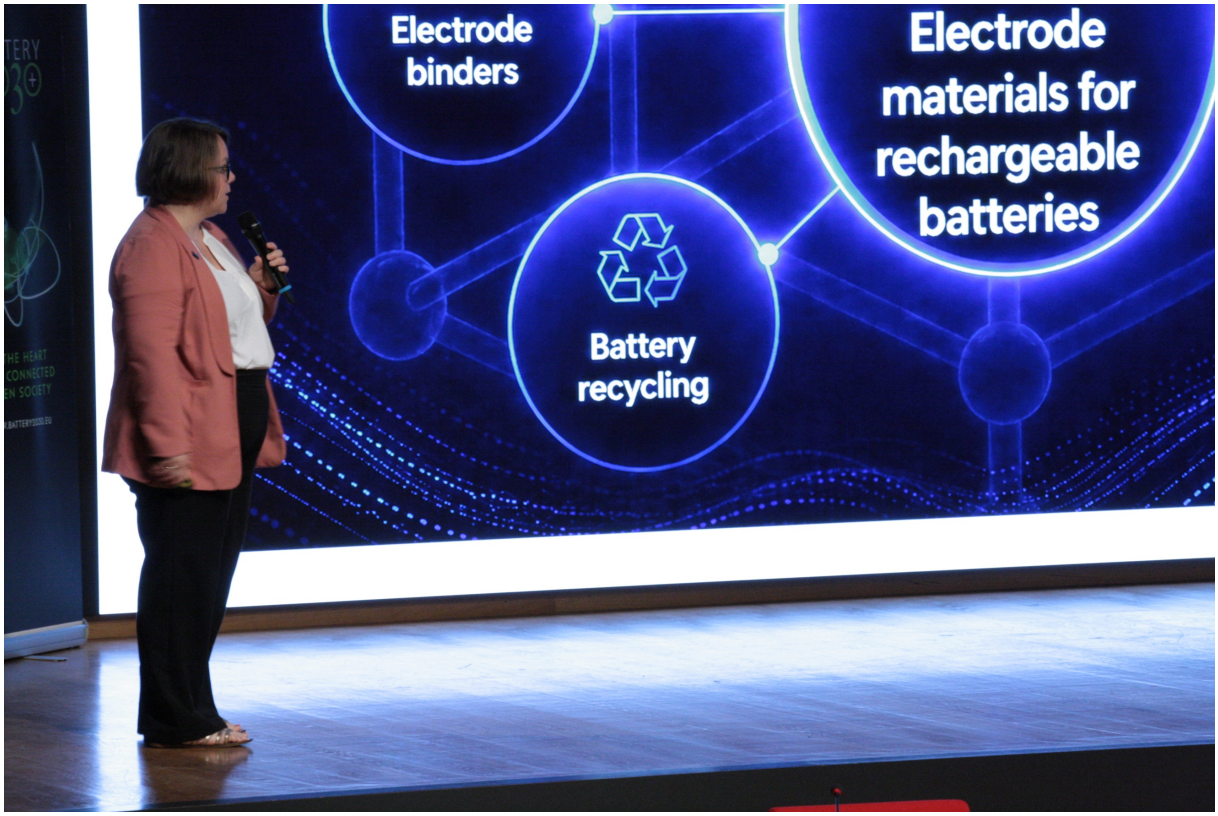
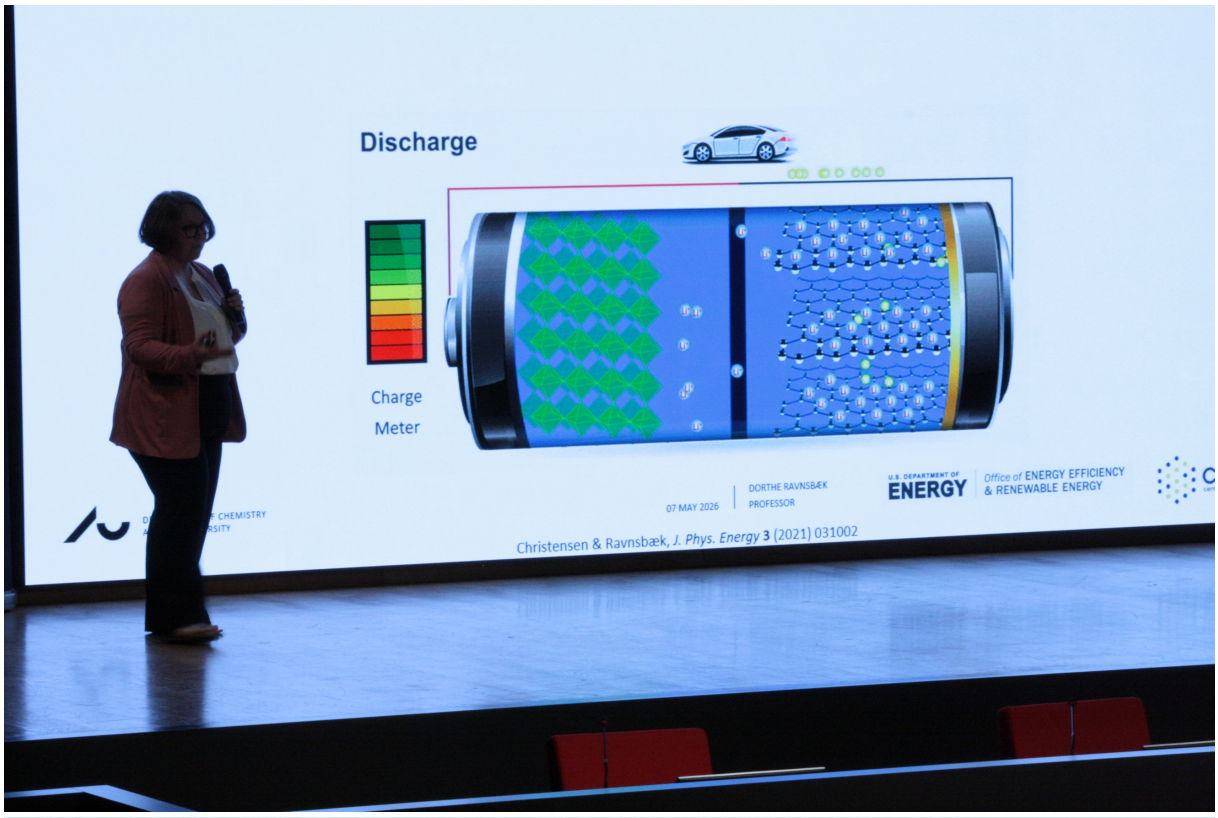
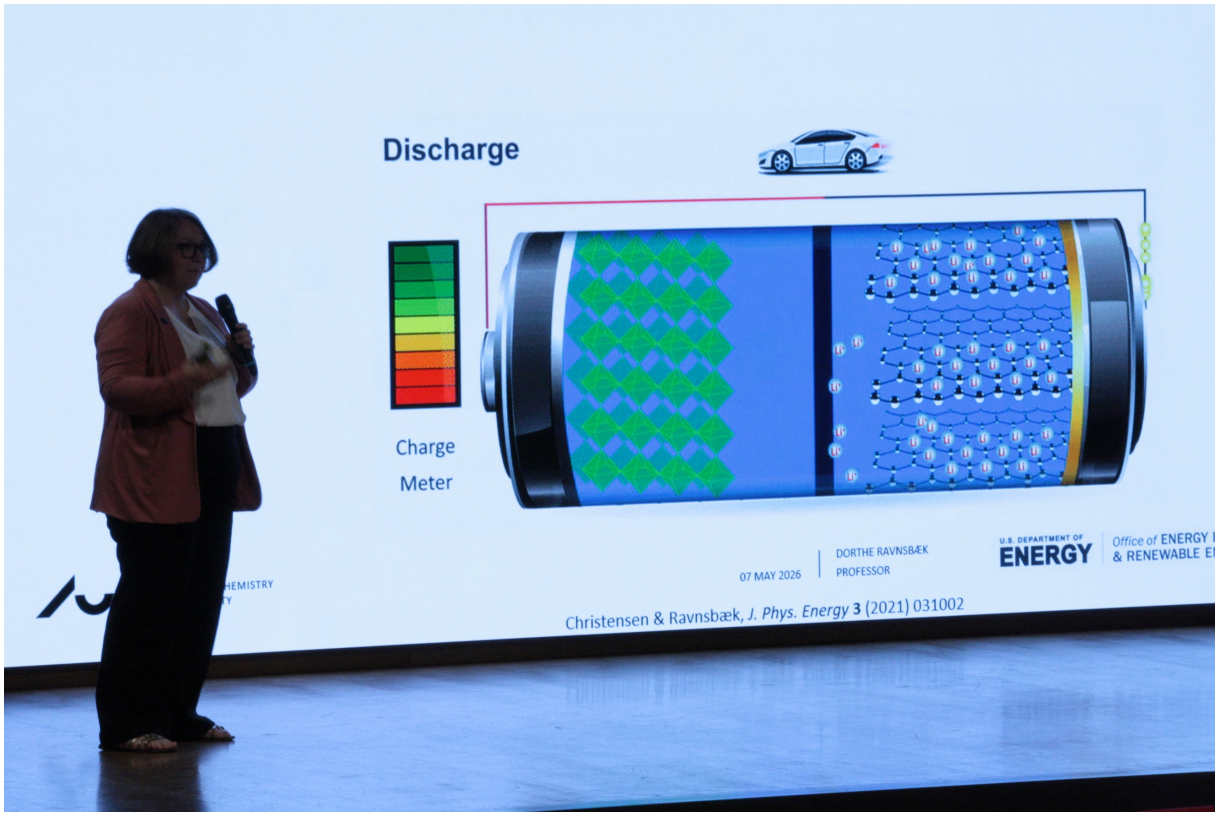
2030


Welcome!
April 27th 2026
Kristina Edström being awarded
"l'Ordre des Palmes Académiques"
by the French Ministry of Education


Buy
Lack of permitting and finance
Estimated realistic share of EU 27production capac
demands based on public announcements with c
Lithium
Graphite
Cobalt
Nickel
Manganese
Precursor material
Refined lithium
Cathod
Skilled
Machinery
Cost comp
A Battery Deal for Europe


Electrode binders
Electrode materials for rechargeable batteries
Battery recycling


Discharge
Charge
Meter
07 MAY 2026
DORTHE RAVNSBÆK
PROFESSOR
U.S. DEPARTMENT OF
ENERGY
Office of ENERGY EFFICIENCY
& RENEWABLE ENERGY
Christensen & Ravnsbæk, J. Phys. Energy 3 (2021) 031002


Discharge
Charge
Meter
07 MAY 2026
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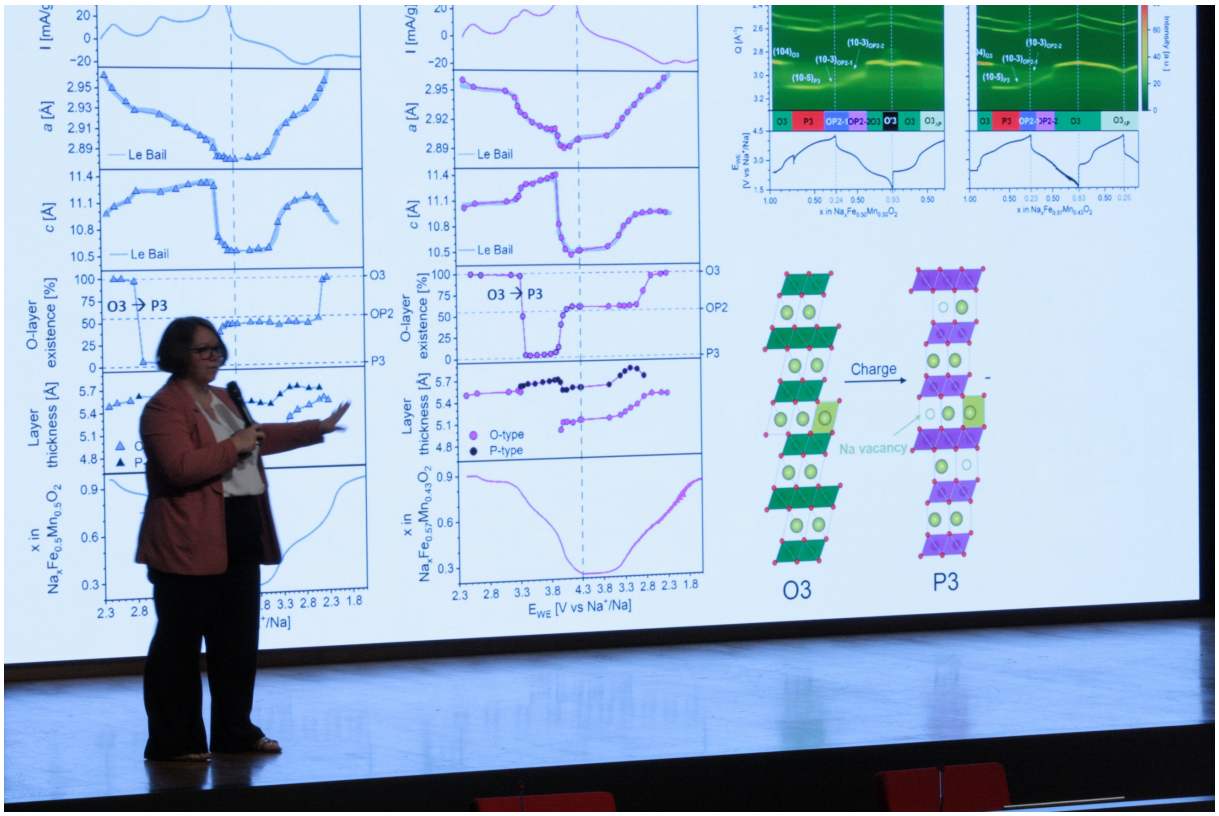
PROFESSOR
U.S. DEPARTMENT OF
ENERGY
Christensen & Ravnsbæk, J. Phys. Energy 3 (2021) 031002


Le Bail
O3 → P3
O-type
P-type
Charge
Na vacancy
O3
P3







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BATTERY 2030+
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Turin, Italy


CENSEMAT
center for sustainable energy materials
Grundforskningsfond
Danish National
Research Foundation
novo nordisk fonden
DET FRIE FORSKNINGSRÅD
DANISH COUNCIL FOR
INDEPENDENT RESEARCH
For Women in Science
InnovationsFonden
FORSKNING, TEKNOLOGI & VÆKST I DANMARK
VILLUM FONDEN
ELITE FORSK
CARLSBERG FOUNDATION
Danish Energy Agency
POUL DUE JENSEN / GRUNDFOS FOUNDATION


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hanks for all your support for me the last years
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UPPSALA UNIVERSITET
Kristina Edström
BATTERY INNOVATION DAYS
Stockholm, Sweden and online
11 - 12 November 2026
WWW.battery2030.eu
LinkedIn: Battery 2030+
This project has recived funding from the European Union's Horizon Europe research and innovation programme under grant number No. 101104022.


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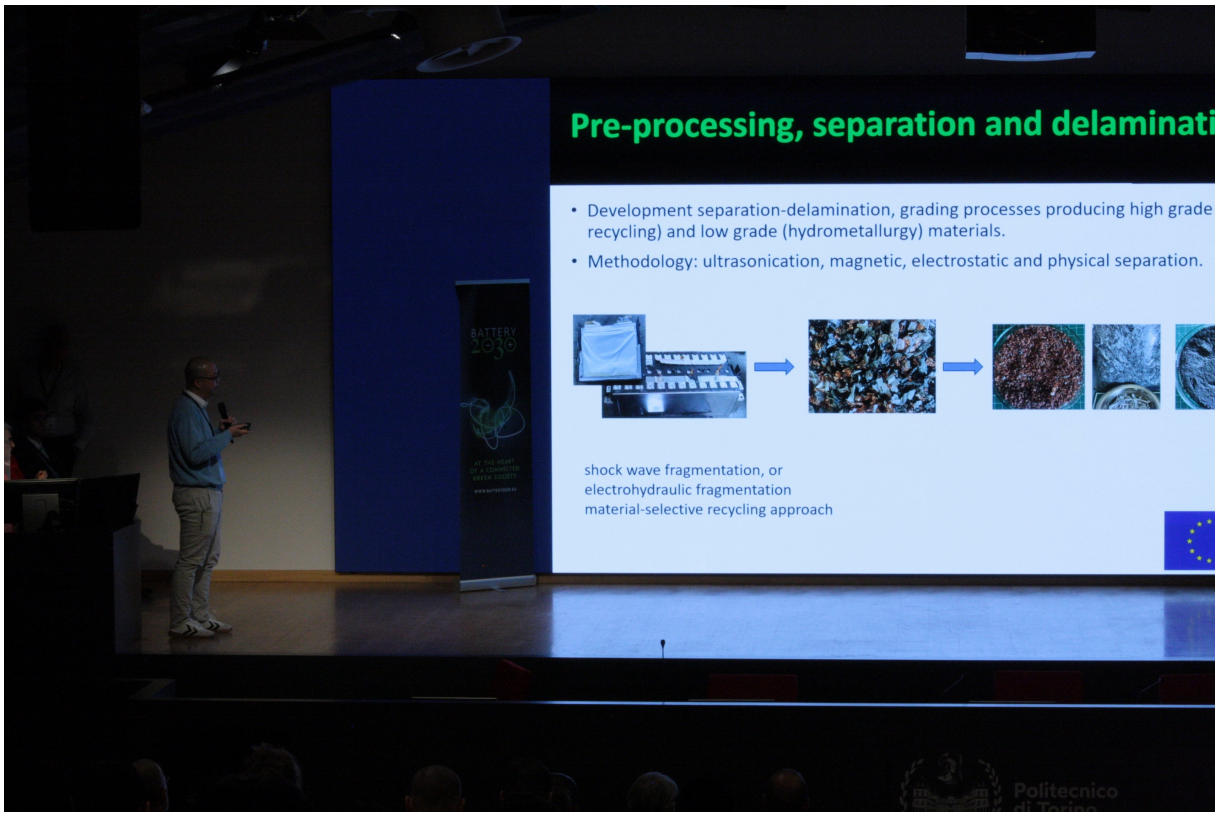
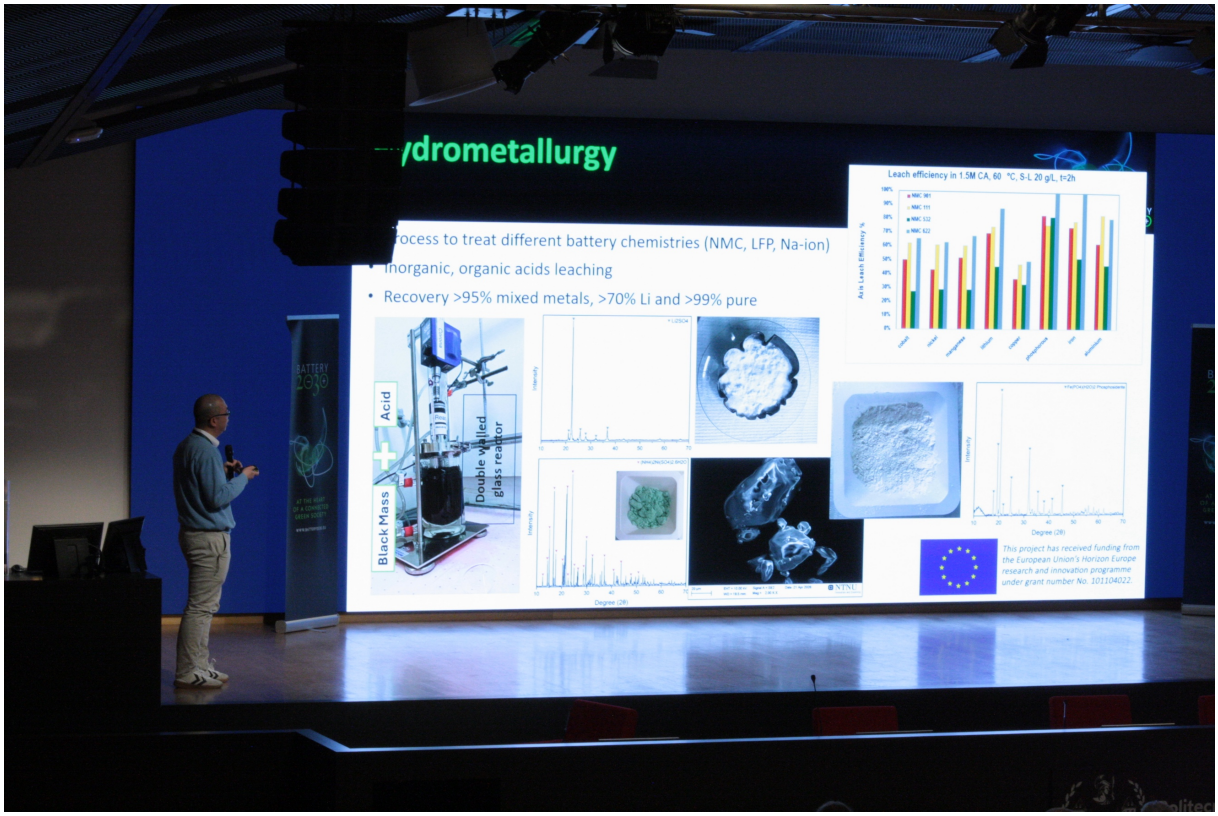
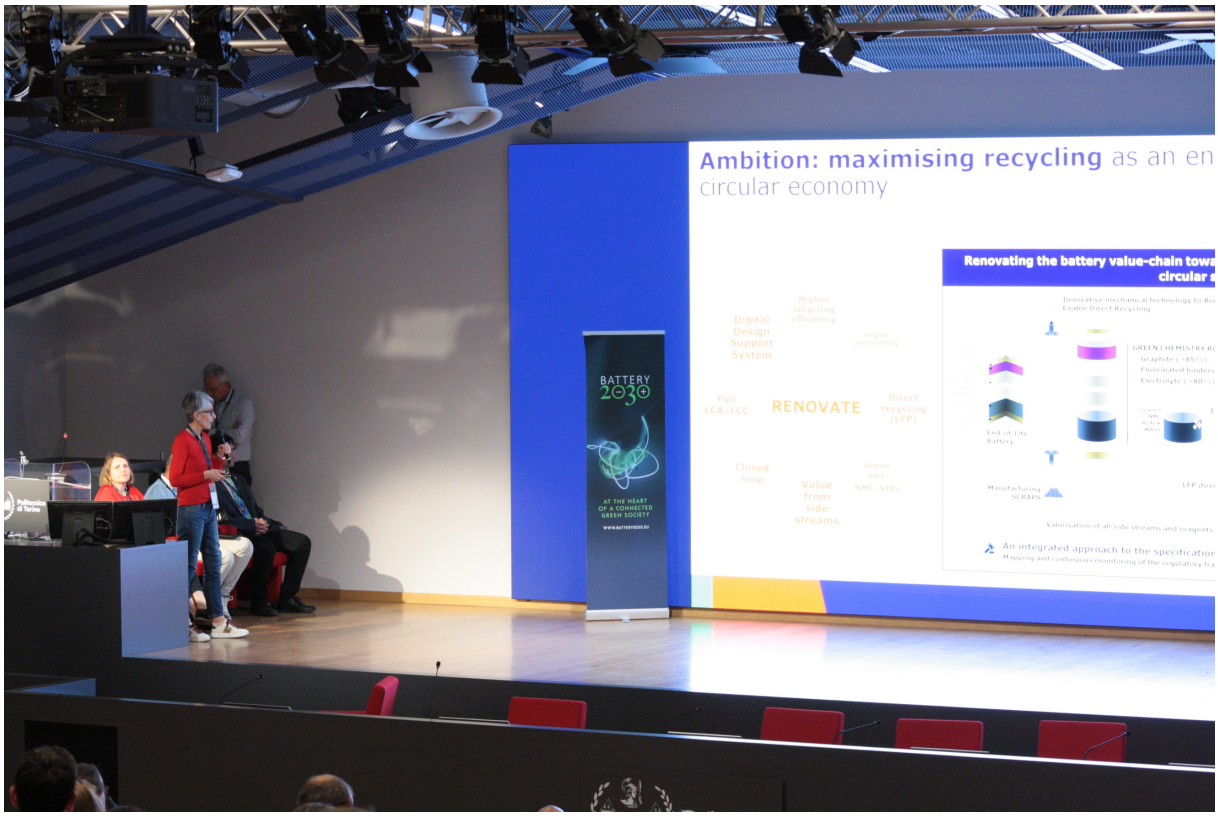

Pre-processing, separation and delaminati
• Development separation-delamination, grading processes producing high grade recycling) and low grade (hydrometallurgy) materials.
• Methodology: ultrasonication, magnetic, electrostatic and physical separation.
shock wave fragmentation, or
electrohydraulic fragmentation
material-selective recycling approach


ydrometallurgy
ocess to treat different battery chemistries (NMC, LFP, Na-ion)
norganic, organic acids leaching
Recovery >95% mixed metals, >70% Li and >99% pure
Acid
Black Mass
Double walled glass reactor
Leach efficiency in 1.5M CA, 60 °C, S-L 20 g/L, t=2h
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant number No. 101104022


Ambition: maximising recycling as an en
circular economy
Renovating the battery value-chain towa
circular
Digital Design Support System
Higher recycling efficiency
Full LCA/LCC
RENOVATE
Direct recycling (LFP)
Closed loop
Value from side streams
Green met
NMC/SIBs
BATTERY 2030
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Innovative mechanical technology to Bo
Enable Direct Recycling
GREEN CHEMISTRY R
Graphite (~80%)
Fluorinated binders
Electrolyte (~80%)
End-of-Life Battery
Manufacturing Scraps
LFP direc
Valorisation of all side streams and reagents
An integrated approach to the specificatior
Mapping and continuous monitoring of the regulatory fra


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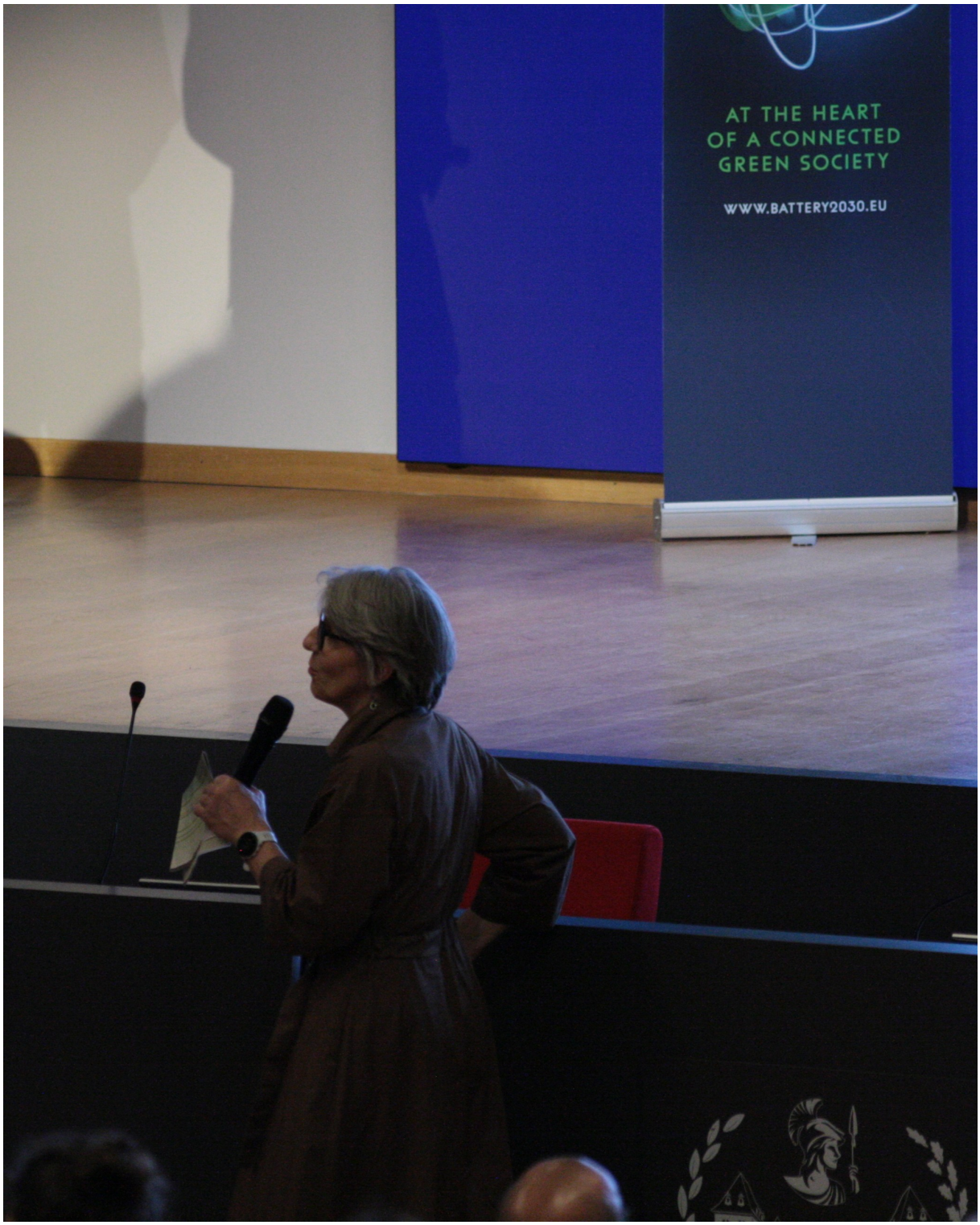
TEP-assisted SFE on PVDF/C composites with known ratio:
Recovery of C-free PVDF in one step
SFE on NMC cathodes (TEP/Acetone)
Best HSPs and higher fluidity
No influence of p in the range studied
Yield increases with T
Multiextraction on NMC cathode sample led to change in morphology:
(a) 0 extractions;
(b) 1 extraction;
(c) 2 extractions
(a)
(b)
(c)
Multiextraction on NMC BM (TEP/Acetone)
→ 36wt.% of residual TEP in the extracts (yellow signals in FTIR)
→ Low to no carbon in the extracts (TG curve matches reference)

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Manufacturability: STELLA
STELLAR
PROJECT
STELLAR
SAFE, SUSTAINABLE, AND HIGH-THROUGHPUT
LITHIUM METAL ANODES FOR GEN 4B/4C/5 B
AVESTA
Presented by:
Rahmandhika Firdauzha Hary Hernandha, Ph.D.
Battery Technology Project Leader, AVESTA Holding, Be
The STELLAR project has received funding from the CINEA, European Commission, through Horizon Europe
programme under Grant Agreement No 101202298, and this work was supported by the Swiss State Secre
Research and Innovation (SERI) under contract number: 25.00208
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Manufacturability: STELL
STELLAR PROJECT
STELLAR
SAFE, SUSTAINABLE, AND HIGH-THROUGHI
LITHIUM METAL ANODES FOR GEN 4B/4C/
AVESTA
www.avestaholding.com
Presented by:
Rahmandhika Firdauzha Hary Hernandha, Ph.D.
Battery Technology Project Leader, AVESTA Holdi
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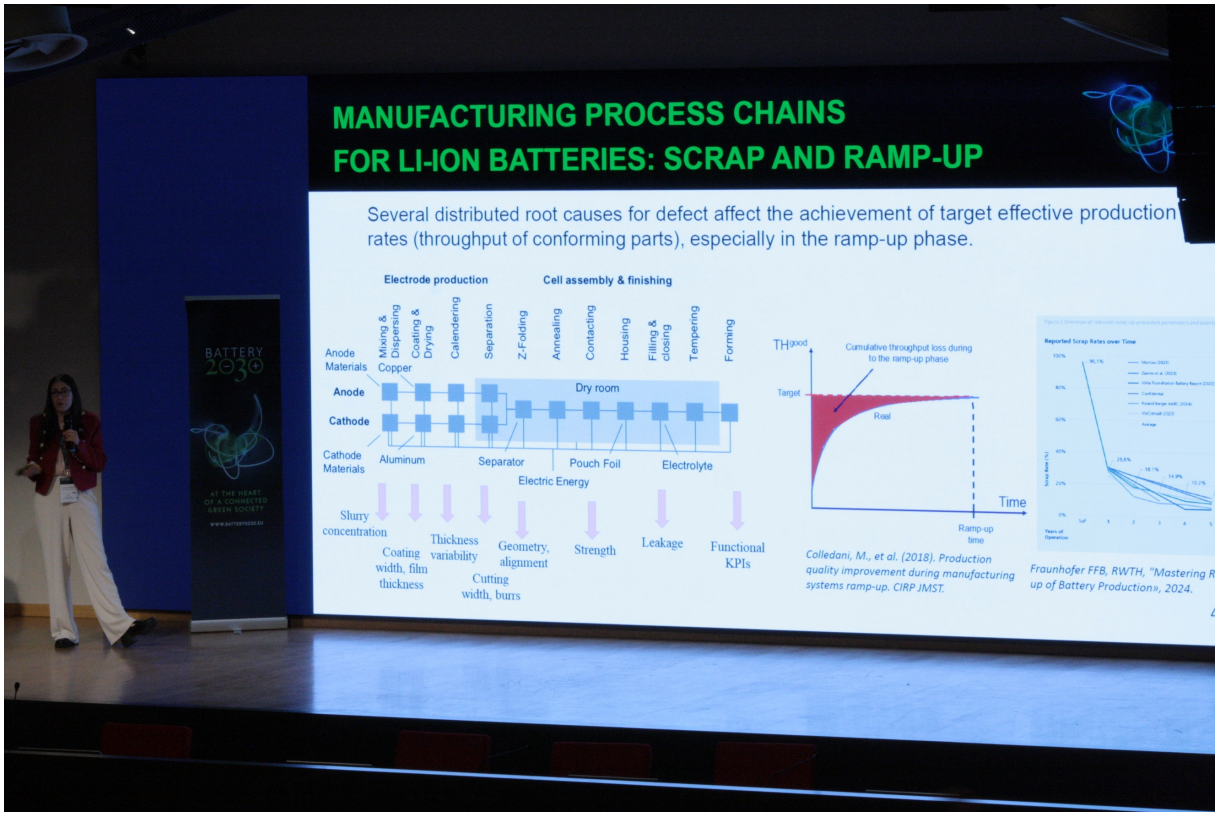
MANUFACTURING PROCESS CHAINS
FOR LI-ION BATTERIES: SCRAP AND RAMP-UP
Several distributed root causes for defect affect the achievement of target effective production rates (throughput of conforming parts), especially in the ramp-up phase.
Electrode production
Cell assembly & finishing
Mixing & Dispersing
Coating & Drying
Calendering
Separation
Z-Folding
Annealing
Contacting
Housing
Filling & closing
Tempering
Forming
Anode Materials
Copper
Anode
Cathode
Dry room
Cathode Materials
Aluminum
Separator
Pouch Foil
Electrolyte
Electric Energy
Slurry concentration
Coating width, film thickness
Thickness variability
Cutting width, burrs
Geometry, alignment
Strength
Leakage
Functional KPIs
TH good
Target
Cumulative throughput loss during to the ramp-up phase
Real
Time
Ramp-up time
Colledani, M., et al. (2018). Production quality improvement during manufacturing systems ramp-up. CIRP JMST.
Reported Scrap Rates over Time
Fraunhofer FFB, RWTH, "Mastering R
up of Battery Production», 2024.
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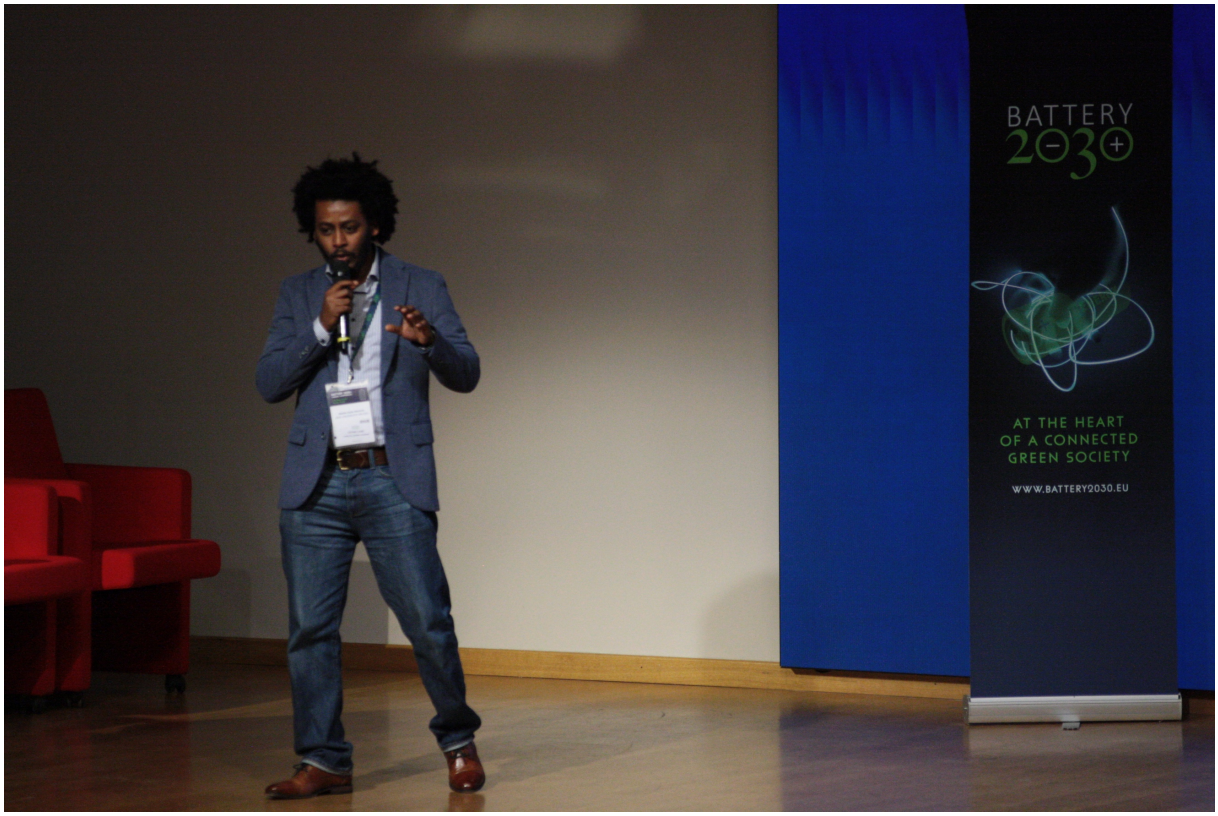
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06 Luciana Morel- UNC
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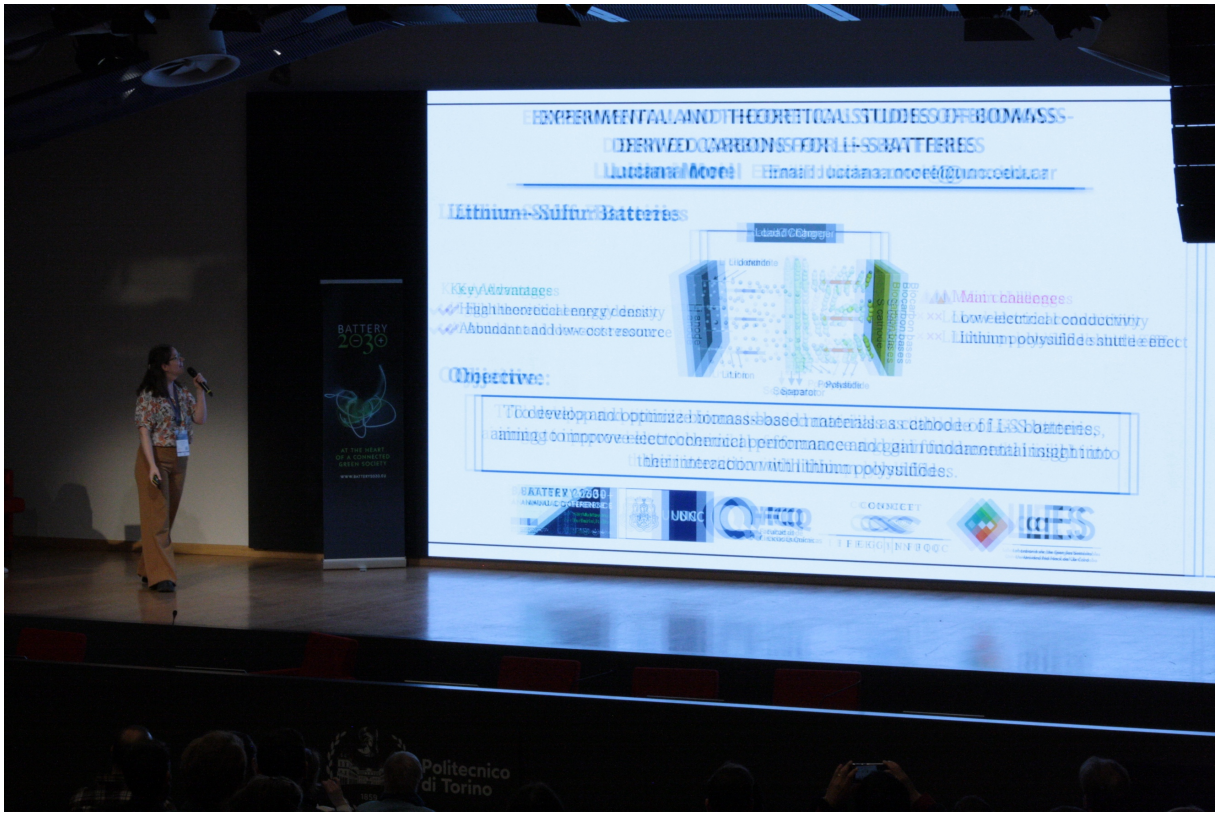
Lithium-Sulfur Batteries
Objective:
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[Senza titolo]
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07 Nada Alghamdi - POLITO
41
A multi-fidelity workflow for discovery of
Diapositiva 37 di 48
Italiano (Italia)


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Diapositiva 37


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A multi-fidelity wor
battery cathodes a
GNoME
Nada Alghamdi[1], Paolo de Angelis
[1]Department of Energy, Polite
Abruzzi, 101
[2]Istituto Nazionale di Ricerca
91, 10135


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ENEA
Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile
BATTERY 203
ANNUAL CONFEREN
Operando Synchrotron Techniques for Next-Generation Batteries: Unlocking Mechanisms Beyond Lithium
Turin 8th May 2026
Giorgia Greco – TERIN-DEC
giorgia.greco@


Operando Facilit
Electrochemical
Near Ambient Pressure
XPS
Electrochemical
Raman
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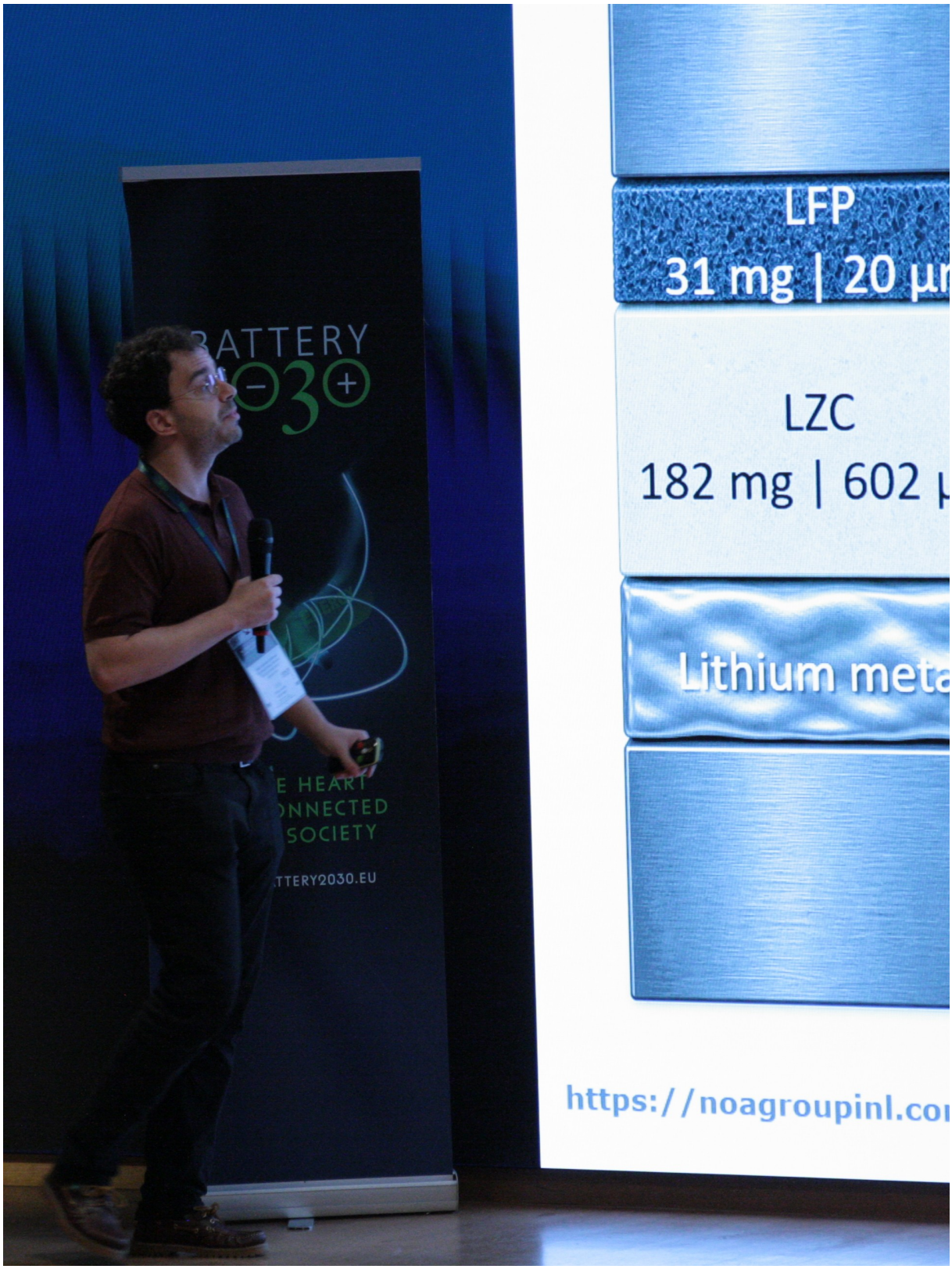
Binding Energy (eV)
Residuals
Signal
Li2ZrCl6
Background
Fit
Temperature
25 °C
80 °C
100 °C
125 °C
150 °C
https://noagroupini.com


LFP
31 mg | 20 µ
LZC
182 mg | 602 µ
Lithium meta
https://noagroupinl.co
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Picture: Pexels


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Audience Voting
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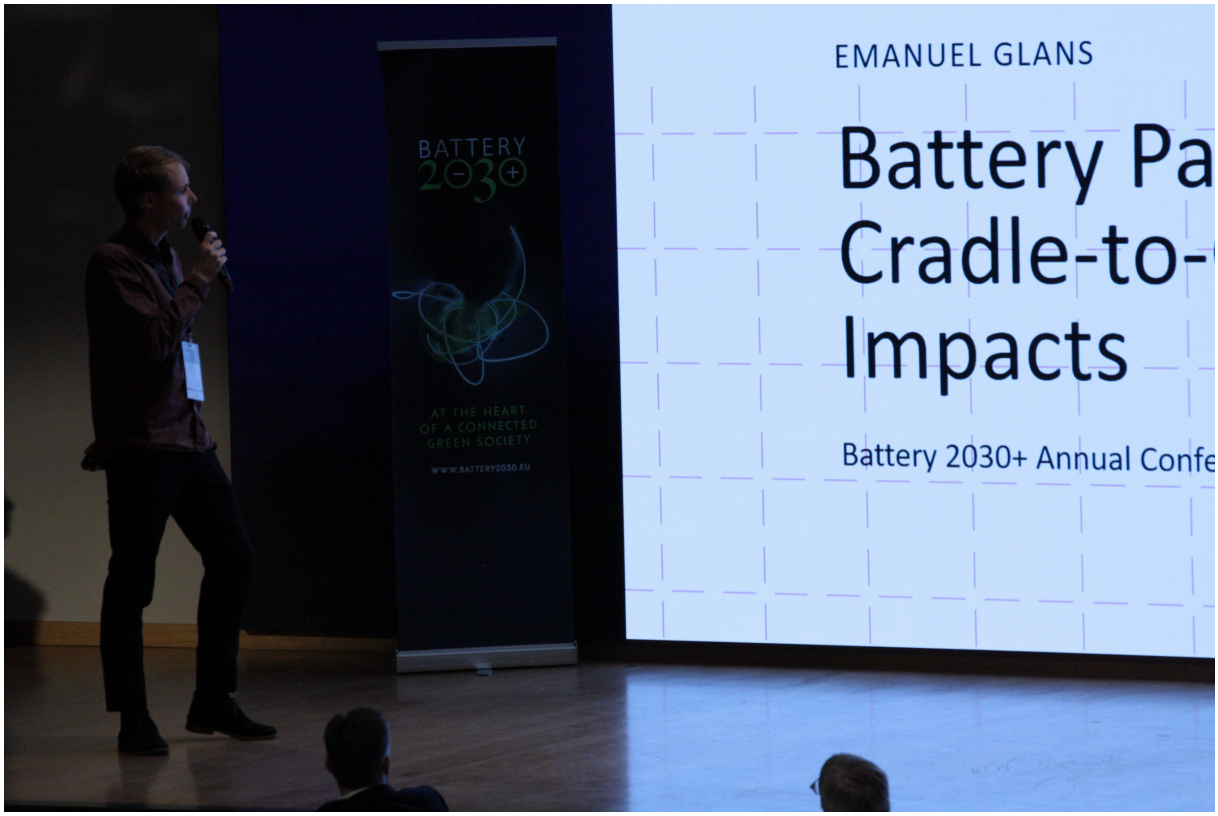
Mechanical Abuse
Electrical Abuse
Thermal Abuse
Deformation
Dendrite Growth
Separator Tearing
Separator Piercing
Internal short circuit
Energy Storage Mater. 2018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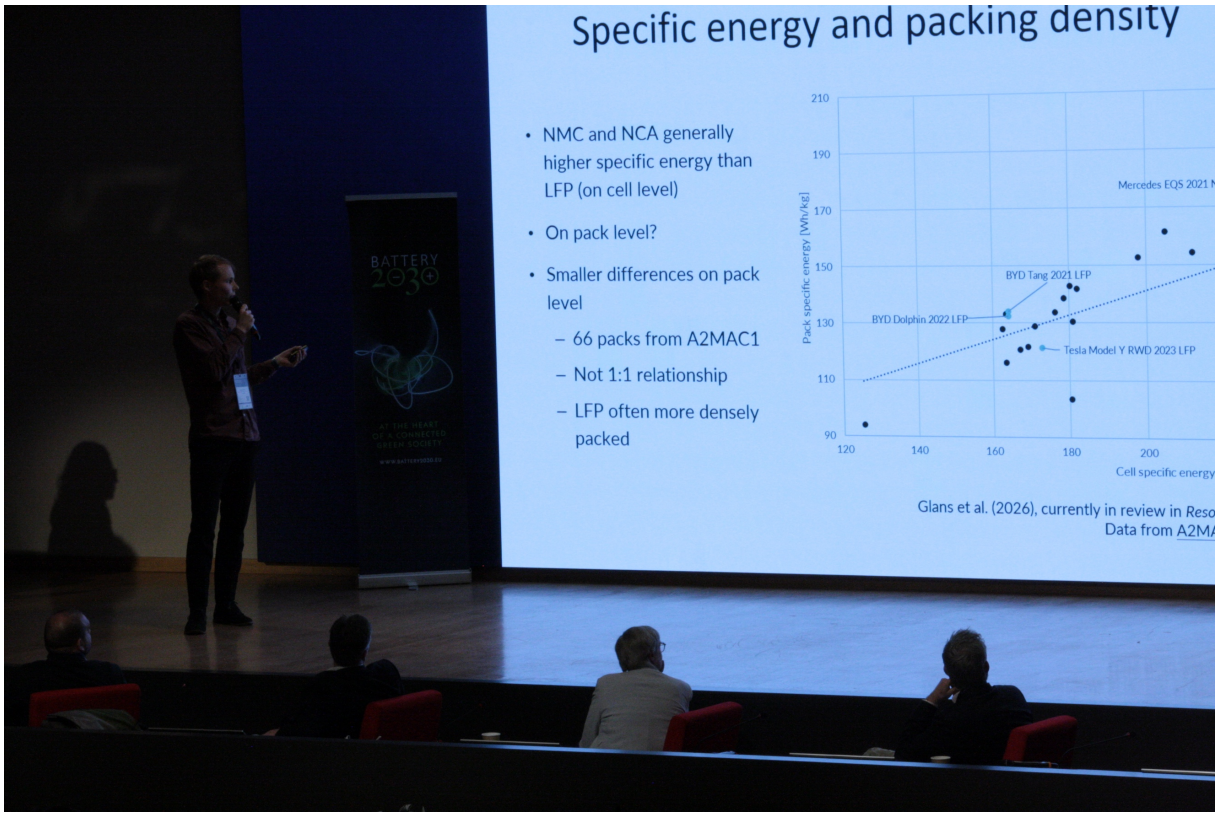
EMANUEL GLANS
Battery Pa
Cradle-to-
Impacts
Battery 2030+ Annual Confe


Specific energy and packing density
• NMC and NCA generally higher specific energy than LFP (on cell level)
• On pack level?
• Smaller differences on pack level
– 66 packs from A2MAC1
– Not 1:1 relationship
– LFP often more densely packed
Pack specific energy [Wh/kg]
Cell specific energy
Mercedes EQS 2021
BYD Tang 2021 LFP
BYD Dolphin 2022 LFP
Tesla Model Y RWD 2023 LFP
210
190
170
150
130
110
90
120
140
160
180
200
Glans et al. (2026), currently in review in Reso
Data from A2MA
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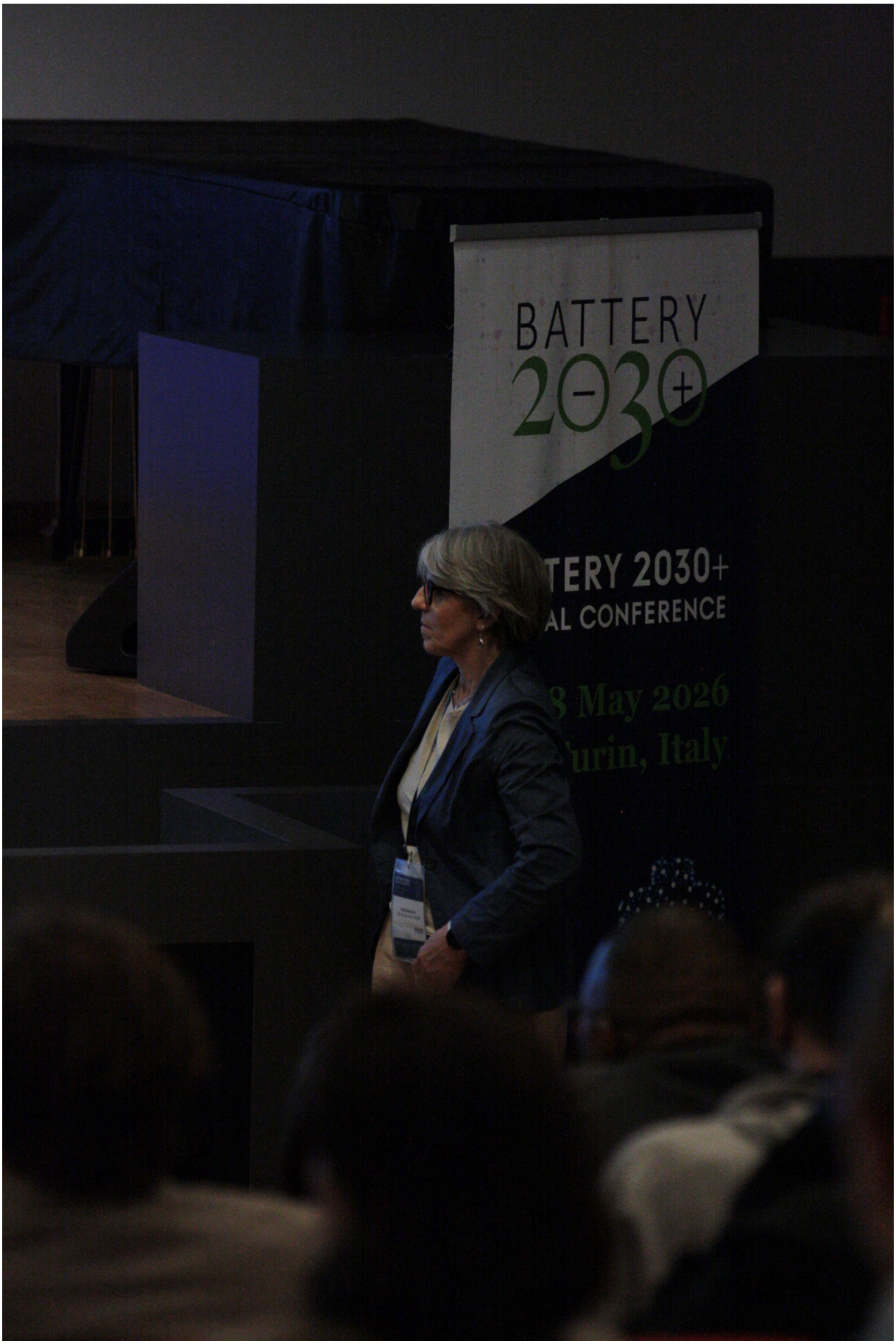
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